STATE OF CALIFORNIA

AIR RESOURCES BOARD

AIR MONITORING QUALITY ASSURANCE

VOLUME V

AUDIT PROCEDURES MANUAL

APPENDIX Y

QUALITY ASSURANCE PROJECT PLAN FOR
THE PM2.5 AMBIENT AIR MONITORING PROGRAM
AT STATE AND LOCAL AIR MONITORING STATIONS (SLAMS)

MONITORING AND LABORATORY DIVISION

OCTOBER 2001

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QUALITY ASSURANCE PROJECT PLAN FOR THE PM2.5 AMBIENT AIR MONITORING PROGRAM AT STATE AND LOCAL AIR MONITORING STATIONS (SLAMS)

Y.0.0 ELEMENT 0 - ACRONYMS AND ABBREVIATIONS

AIRS	Aerometric Information Retrieval System
AMTAC	Air Monitoring Technical Advisory Committee
ANSI	American National Standards Institute
APS	Air Pollution Specialist
APTI	Air Pollution Training Institute
AQDAS	Air Quality Data Acquisition System
AQDB	Air Quality Data Branch
AQDRS	Air Quality Data Review Section
AQM-C	Air Quality Monitoring - Central
AQM-N	Air Quality Monitoring - North
AQM-S	Air Quality Monitoring - South
AQSB	Air Quality Surveillance Branch
ARB	Air Resources Board
ASTM	American Society for Testing and Materials
AWMA	Air and Waste Management Association
CAA	Clean Air Act
CFR	Code of Federal Regulations
DAS	Data Acquisition System
DQA	Data Quality Assessment
DQOs	Data Quality Objectives
NLB	Northern Laboratory Branch
EMAD	Emissions, Monitoring, and Analysis Division
FEM	Federal Equivalent Method
FIPS	Federal Information Processing Standards
FRM	Federal Reference Method
GIS	Geographical Information Systems
GLP	Good Laboratory Practice
GPS	Global Positioning System
HVAC	Heating Ventilation and Air Conditioning
ILS	Inorganic Laboratory Section
LIMS	Laboratory Information Management System
LPM	Liters Per Minute
MLD	Monitoring and Laboratory Division
MOU	Memorandum of Understanding
MQAG	Monitoring and Quality Assurance Group
MQOs	Measurement Quality Objectives
NAAQS	National Ambient Air Quality Standards
NAMS	National Air Monitoring Station
NIST	National Institute of Standards and Technology
NPAP	National Performance Audit Program

OAQPS	Office of Air Quality Planning and Standards
OARM	Office of Administration and Resources Management
ORD	Office of Research and Development
PAMS	Photochemical Assessment Monitoring Stations
PE&S	Program Evaluation and Standards
PM2.5	Particulate Matter $\leq$ 2.5 Microns
POC	Pollutant Occurrence Code
PTFE	Polytetrafluoroethylene
PTSD	Planning and Technical Support Division
Q_a	Sampler Flow Rate at Ambient (actual) Conditions of Temperature and Pressure.
QA	Quality Assurance
QA/QC	Quality Assurance/Quality Control
QAAR	Quality Assurance Annual Report
QAPP	Quality Assurance Project Plan
QAS	Quality Assurance Section
QMB	Quality Management Branch
QMP	Quality Management Plan
R&P	Rupprecht & Patashnick
SA	System Audit
SAS	Special Analysis Section
SIPS	State Implementation Plans
SLAMS	State and Local Air Monitoring Stations
SOP	Standard Operating Procedure
SPM	Special Purpose Monitoring
SPMS	Special Purpose Monitoring Stations
T_a	Temperature, Ambient or Actual
TSP	Total Suspended Particulate
U.S. EPA	United States Environmental Protection Agency
V_a	Air Volume, at ambient or actual conditions
VOC	Volatile Organic Compound
WAM	Work Assignment Manager

Y.1.0 ELEMENT 1 - TITLE AND APPROVAL PAGE

Title: California Air Resources Board (ARB) Quality Assurance Project Plan (QAPP) for the PM2.5 Ambient Air Monitoring Program at State and Local Air Monitoring Stations (SLAMS)

The attached QAPP for the PM2.5 Ambient Air Quality Monitoring Program is hereby recommended for approval and commits the ARB to follow the elements described within.

California ARB

1) Signature:____Date:________________
William V. Loscutoff - Chief, Monitoring and Laboratory Division

2) Signature: _______________________________________ Date: ________________
Jeffrey P. Cook - Chief, Quality Management Branch

3) Signature: ____Date:________________
Mike Miguel - Manager, Quality Assurance Section

U.S. EPA Region IX

1) Signature: ____Date:________________
John Kennedy - Chief, Air Division - Technical Support Office

2) Signature:____Date:________________
Vance S. Fong, P.E., - Manager, Policy and Management Division, Quality Assurance Office

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Y.3.0 ELEMENT 3 - DISTRIBUTION LIST

A copy of this QAPP has been distributed to the individuals in Table Y.3.0.1.

Table Y.3.0.1
Distribution List

CALIFORNIA ARB STAFF

MLD Division Chief Mr. William V. Loscutoff	MLD NLB Mr. Mike Poore	MLD PES&S Mr. Cliff Popejoy
MLD AQM-Central Mr. Peter Ouchida	MLD QMB Mr. Jeff Cook	PTSD AQDRS Mr. Ron Rothacker
MLD-EL MONTE AQM-South Mr. Curt Schreiber	MLD SAS Mr. Russell Grace	MLD NLB Mr. Lyman Dinkins
MLD QMB Mr. Jeff Cook	PTSD AQDRS Mr. Ron Rothacker	MLD-EL MONTE AQM-South Mr. Curt Schreiber
MLD SAS Mr. Russell Grace	MLD AQSB Mr. Ken Stroud	MLD AQM-North Mr. Lowell Jarvis
MLD QAS Mike Miguel	PTSD AQDRS Mr. Bob Maxwell	MLD QAS Mr. Sam Vogt
MLD AQM-Central Mr. Jack Romans	MLD Operations Support Mr. Reginald Smith	MLD NLD Mr. Dan Tackett

CALIFORNIA ARB STAFF (CONT.).

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AQDRS

Ms. Katazyn Turkiewicz

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Kern County APCD
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Mr. Robert Reynolds, APCO

Lassen County APCD
Mr. Kenneth Smith, APCO

Mariposa County APCD
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Mendocino County APCD
Mr. Philip Towle, APCO

Modoc County APCD
Mr. Joe Moreo, APCO

Mojave Desert AQMD
Mr. Charles Fryxell, APCO

Mojave Desert AQMD
Mr. Robert Ramirez

Monterey Bay Unified APCD
Mr. Doug Quetin, APCO

Monterey Bay Unified APCD
Mr. John Fear

North Coast Unified AQMD
Mr. Wayne Morgan, APCO

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Mr. Bob Torzynski

Northern Sierra AQMD
Mr. Rod Hill, APCO

Northern Sierra AQMD
Mr. Joe Fish

Northern Sonoma County APCD
Ms. Barbara Lee, APCO

Northern Sonoma County APCD
Mr. Randall Woodard

Placer County APCD
Mr.Todd Nishikawa, APCO

Placer County APCD
Mr. David Vintze

Sacramento Metropolitan AQMD
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Sacramento Metropolitan AQMD
Mr. John Ching

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San Diego County APCD
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San Joaquin Valley Unified APCD
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Mr. David Jones

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Mr. Robert Carr, APCO

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Santa Barbara County APCD
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Mr. Joe Cordes

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South Coast AQMD
Mr. Mel Zeldin

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Mr. Rudy Eden

South Coast AQMD
Mr. Thomas Parsons

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Ms. Corie Choa

Tehama County, APCD
Mr. Mark Black, APCO

Tehama County APCD
Mr. Gary Bovee

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Mr. Richard Baldwin, APCO

Ventura County, APCD
Mr. Doug Tubbs

Yolo-Solano AQMD
Mr. Larry Greene, APCO

Yolo-Solano AQMD
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U.S. EPA Region IX
Mr. Vance Fong

U.S. EPA Region IX
Mr. Manny Aquitania

U.S. EPA Region IX
Mr. Mathew Plate

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Mr. Bob Pallarino

U.S. EPA Region IX
Katherine Brown

U.S. EPA Region IX
Vallerie Cooper

Y.4.0 ELEMENT 4 - PROJECT/TASK ORGANIZATION

Y.4.1 ROLES AND RESPONSIBILITIES

Federal, State, and local agencies all have important roles in developing and implementing satisfactory air monitoring programs. As part of the planning effort, U.S. EPA is responsible for developing National Ambient Air Quality Standards (NAAQS), defining the quality of the data necessary to make comparisons to the NAAQS, and identifying a minimum set of QC samples from which to judge data quality. The State and local organizations are responsible for taking this information and developing and implementing a quality system that will meet the data quality requirements. Then, it is the responsibility of both U.S. EPA and the State and local organizations to assess the quality of the data and take corrective action when appropriate. The responsibilities of each organization follow.

Y.4.1.1 <u>OFFICE OF AIR QUALITY PLANNING AND STANDARDS (OAQPS)</u>

OAQPS is the organization charged under the authority of the Clean Air Act (CAA) to protect and enhance the quality of the nation's air resources. OAQPS sets standards for pollutants considered harmful to public health or welfare and, in cooperation with U.S. EPA's Regional Offices and the states, enforces compliance with the standards through state implementation plans (SIPs) and regulations controlling emissions from stationary sources. The OAQPS evaluates the need to regulate potential air pollutants and develops national standards; works with State and local agencies to develop plans for meeting these standards; monitors national air quality trends and maintains a database of information on air pollution and controls; provides technical guidance and training on air pollution control strategies; and monitors compliance with air pollution standards.

Within the OAQPS Emissions Monitoring and Analysis Division, the Monitoring and Quality Assurance Group (MQAG) is responsible for the oversight of the Ambient Air Quality Monitoring Network. MQAG has the following responsibilities:

- ensures that the methods and procedures used in making air pollution measurements are adequate to meet the programs objectives and that the resulting data are of satisfactory quality
- operates the National Performance Audit Program (NPAP) and the FRM Performance Evaluation
- evaluates the performance, through technical systems audits and management systems reviews, of organizations making air pollution measurements of importance to the regulatory process
- implements satisfactory quality assurance programs over U.S. EPA's Ambient Air Quality Monitoring Network
- ensures that national regional laboratories are available to support chemical speciation and QA programs

- ensures that guidance pertaining to the quality assurance aspects of the Ambient Air Program are written and revised as necessary
- renders technical assistance to the U.S. EPA Regional Offices and air pollution monitoring community

Y.4.1.2 U.S. EPA REGION IX OFFICE

U.S. EPA Regional Offices have been developed to address environmental issues related to the states within their jurisdiction and to administer and oversee regulatory and congressionally mandated programs. The major quality assurance responsibilities of U.S. EPA's Region IX Office, in regards to the Ambient Air Quality Program, are the coordination of quality assurance matters at the Regional levels with the State and local agencies. This is accomplished by the designation of U.S. EPA Regional Project Officers who are responsible for the technical aspects of the program including:

- review QAPPs by Regional QA Officers who are delegated the authority by the Regional Administrator to review and approve QAPPs for the Agency
- support the FRM Performance Evaluation Program
- evaluate quality system performance, through technical systems audits and network reviews whose frequency is addressed in the Code of Federal Regulations and Section 20
- act as liaisons by making available the technical and quality assurance information developed by U.S. EPA Headquarters and the Region to the State and local agencies, and make U.S. EPA Headquarters aware of the unmet quality assurance needs of the State and local agencies

California ARB will direct technical and QA questions to Region IX.

Y.4.1.3 CALIFORNIA ARB

The ARB's mission is to promote and protect public health, welfare, and ecological resources through the effective and efficient reduction of air pollutants while recognizing and considering the effects on the economy of the State. By legislative mandate, the ARB has oversight of California's air pollution control program with the responsibility for improving and maintaining the air quality in the State.

40 CFR Part 58 defines a State Agency as "the air pollution control agency primarily responsible for the development and implementation of a plan (SIP) under the Act (CAA)". Section 302 of the CAA provides a more detailed description of the air pollution control agency.

40 CFR Part 58 defines the Local Agency as "any local government agency, other than the state agency, which is charged with the responsibility for carrying out a portion of the plan (SIP)".

The major responsibility of State and local agencies is the implementation of a satisfactory monitoring program, which would naturally include the implementation of an appropriate quality assurance program. It is the responsibility of State and local agencies to implement quality assurance programs in all phases of the air monitoring network, including the field, their own laboratories, and in any consulting and contractor laboratories which they may use to obtain data. The network operations are defined as work performed to obtain, use, or report information pertaining to environmental processes or conditions.

Figure Y.4.0.1 represents the organizational structure of the areas of the ARB that are responsible for the activities of the PM2.5 Ambient Air Quality Monitoring Program. The following information lists the specific responsibilities of each individual and are grouped by functions of the Executive Officer, Monitoring and Laboratory Division, and Planning and Technical Support Division.

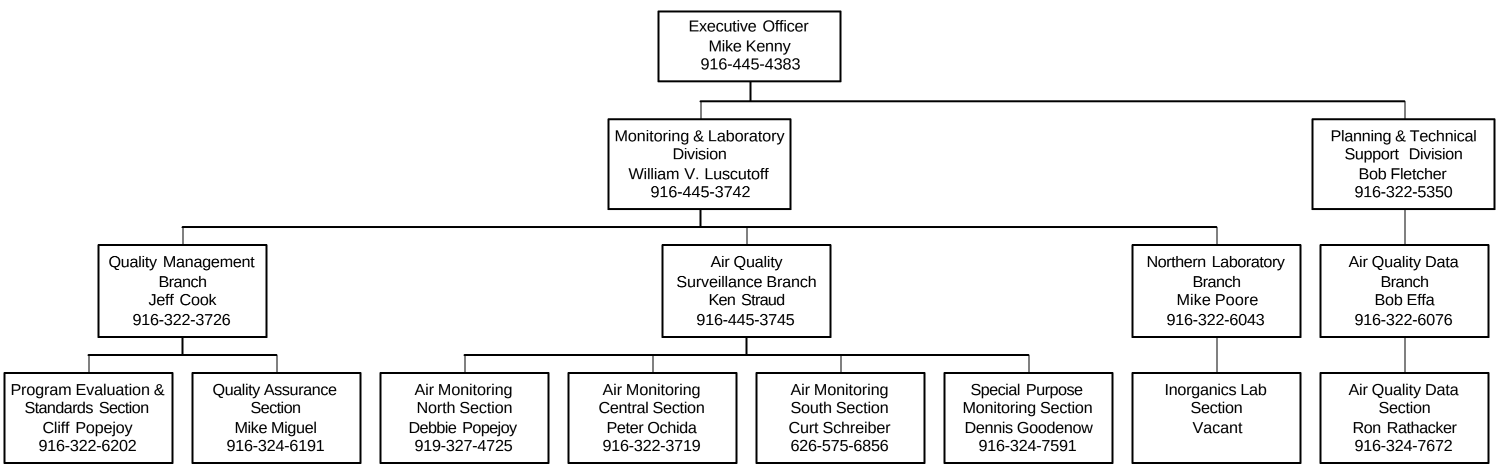

Figure Y.4.0.1
Organizational Structure of California ARB for PM2.5 Air Monitoring

Y.4.1.3.1 EXECUTIVE OFFICER

Executive Officer - Mike Kenny

Serves the ARB, which may delegate any duty to the Executive Officer that the ARB deems appropriate. Performs and discharges, under the direction and control of the ARB, the powers and duties vested in the ARB and delegated to the Executive Officer by the ARB.

Y.4.1.3.2 MONITORING AND LABORATORY DIVISION (MLD)

MLD supports California's Air Quality Management Program by providing timely and accurate ambient and source level measurements to define the nature, extent and trend of air quality in the State.

MLD Chief - William V. Loscutoff

Under administrative direction of the ARB and its Chief Deputy Executive Officer, plans organizes and directs the work of the Monitoring and Laboratory Division program and staff; formulates policy recommendations to the ARB and Executive Officer; acts as a member of the Executive Staff; identifies issues, formulates policy, and develops strategies to meet the ARB mission and program objectives. The MLD chief's responsibilities include:

- coordinates, plans, organizes and directs the activities of the MLD
- operates a data collection network of air quality monitors
- assures data is scientifically valid and meets stringent air quality standards
- ensures data is processed on a timely manner and made available to local officials
- develops and improves techniques for sampling pollutants whose chemical nature and concentration can change during sampling, storage and transport
- operates state-of-the-art scientific laboratories
- develops and improves laboratory methods and procedures
- assures the quality of all data generated in the laboratories by checking the accuracy and repeatability of measurement techniques
- assures that highly complex and sensitive instrumentation such as gas chromatographs and mass spectrometers function properly
- conducts correlation testing and repair of complex instrumentation
- maintains calibration gases and instrumentation
- collects and analyzes samples
- develops test methods
- maintains a field monitoring network of testing stations throughout the State

The MLD Chief represents the ARB before legislative committees; appears before the ARB; prepares reports and correspondence; implements ARB administrative policies and procedures; and represents the ARB at meetings, conferences, and hearings.

Three branches within the MLD are responsible for collection, validation, and submittal of air quality data, including PM2.5. These branches are: Air Quality Surveillance Branch (AQSB); Quality Management Branch (QMB); and Northern Laboratory Branch (NLB).

AQSB Chief - Ken Stroud

The AQSB supports the ARB's air pollution control program by providing accurate ambient air monitoring data measurements to define the nature, extent and trend of air pollution throughout California. The AQSB is divided into four sections: Air Quality Monitoring - South (AQM-S), AQM - Central (AQM-C), AQM - North (AQM-N) and Special Purpose Monitoring (SPM).

The AQSB Chief supervises the AQM-N Section, the AQM-S Section, the AQM-C Section and the SPM Section. Is responsible for overseeing that the ARB ambient air monitoring stations throughout California are operated in accordance to proper standard operating procedures. Oversees the collection and validation of the ambient air quality data collected by ARB stations; the performance audits conducted on air monitoring stations throughout California; that precision checks meet standards; and that calibrations are conducted on all ARB sites. Assures that staff have the resources necessary to maintain yearly sampling schedules for gaseous analyzers, PM10, PM2.5, dichots, toxics, NMOC, etc. Oversees the repair and acceptance testing of air monitoring instrumentation of ARB and local district equipment. Assures that the ARB's Air Quality Data Acquisition System (AQDAS) II provides ambient air quality data to ARB's Planning and Technical Support Division (PTSD) and U.S. EPA's Aerometric Information Retrieval System (AIRS) in a timely manner. Acts as Chairman to the ARB's Air Monitoring Technical Advisory Committee (AMTAC). Responsibilities include:

- provides oversight and leadership to Branch in planning, developing and designing all ARB and monitoring projects in California
- advises and assists the MLD Chief in formulating policy and developing, planning and evaluating MLD activities
- acts as MLD interface with local air districts throughout the State on issues related to air monitoring
- represents the MLD at meeting, conferences, working groups and forums that relate to ambient air monitoring issues throughout California, and acts as Chairman of AMTAC, as directed by the MLD Chief
- prepares reports, reviews correspondence and reviews, edits and approves technical reports of staff
- stays current on new technology and acts as MLD expert on monitoring instrumentation

- coordinates air monitoring activities with U.S. EPA Region IX as they relate to federal 105 and 103 Grants
- assures that ambient air monitoring data from ARB stations operated in California as they relate to Grant funding are submitted as required.
- provides the resources necessary to fulfill the AQSB's ambient air monitoring responsibilities

AQM-S Section Manager - Curtis Schreiber

The AQM-S Section supports the ARB's air pollution control program by providing accurate ambient air monitoring data measurements to define the nature, extent and trend of air pollution throughout California.

The AQM-S Section Manager manages the AQM-S Section for the AQSB. Specific air monitoring station responsibilities include the areas of San Luis Obispo, Santa Barbara, and Calexico, California. Must also provide support to the local air quality districts. Coordinates the collection and validation of special project reports, as assigned to his section; the development of yearly calibration schedules for his section to be submitted to manager of the SPM Section by December of each year; the collection and review of calibration reports and associated stripcharts for his section; and the tracking of precision checks for his section. Also provides his staff with the resources necessary to maintain yearly sampling schedules for gaseous analyzers, PM10, PM2.5, dichots, toxics, NMOC and TSP (lead). The manager will coordinate the ordering, stocking and inventorying of all air monitoring equipment used by the section. Responsibilities include:

- provides leadership to Air Pollution Specialists (APS) in planning, developing and designing and operating ARB air monitoring stations and monitoring projects in the southwestern areas of California south to the Mexican border
- provides calibration and repair services for continuous ambient air monitoring, as well as special purpose monitoring stations
- makes sure all ambient air quality data are submitted to the SPM Section in a timely manner
- directs the ARB's toxic air sampling program in southern California by making sure the instrumentation used to collect the samples are properly calibrated and operating
- assigns calibration and repair duties as necessary, and provides training for local districts in their operation as necessary
- provides leadership for the APSs and Technicians in the purchase, testing, training of personnel, development of QC procedures and operation of ambient air monitoring instrumentation
- represents the MLD at meetings, conferences, working groups and forums that relate to ambient air monitoring issues throughout California, as directed by the AQSB chief.

AQM-C Section Manager - Peter Ouchida

The AQM-C Section supports the ARB's air pollution control program by providing accurate ambient air monitoring data measurements to define the nature, extent and trend of air pollution throughout California.

The AQM-C Section Manager manages the AQM-C Section for the AQSB. Specific air monitoring station responsibilities covers the area of Modesto to Bakersfield east to the Nevada border. Coordinates the collection and validation of special project reports, as assigned to his section; the development of yearly calibration schedules for his section to be submitted to the manager of the SPM Section by December of each year; the collection and review of calibration reports and associated stripcharts for his section; and the tracking of precision checks for his section. Also makes sure his staff has the resources necessary to maintain yearly sampling schedules for gaseous analyzers, PM10, PM2.5, dichots, toxics, NMOC, and TSP (lead) . Coordinates ordering, stocking and inventorying of all air monitoring equipment used by the section. Responsibilities include:

< provides leadership to APSs in planning, developing and designing all ARB air monitoring stations and monitoring projects in the California's Central Valley and east to the Nevada border.
< makes sure all ambient air quality data are submitted to the SPM Section in a timely manner
< provides leadership for the APSs and Technicians in the purchase, testing, training of personnel, development of QC procedures and operation of ambient air monitoring instrumentation which includes: developing, designing and preparing performance specifications and testing protocols for a wide range of complex scientific instrumentation and their associated support systems
< oversees testing and assists in developing evaluation reports for new instrumentation
< represents the MLD at meetings, conferences, working groups and forums that relate to ambient air monitoring issues throughout California, as directed by the AQSB chief

AQM-N Section Manager - Debbie Popejoy

The section operates, calibrates, installs, maintains and repairs air monitoring, meteorological, data acquisition, particulate sampling, toxic compound sampling and calibration instrumentation at field air monitoring sites in Northern California and retrieves, processes, edits and reports air quality data resulting from the operation of the field air monitoring equipment mentioned above. Troubleshoots, repairs, retrofits, modifies and acceptance tests all ambient air monitoring, meteorological, data acquisition, particulate and toxic compound sampling, automatic calibration and test instrumentation operated in the Statewide ARB air quality monitoring network, and eight (8) local air pollution control agencies. These duties are performed in the instrument laboratory located in Sacramento. Cooperates with local air pollution control agencies to improve the accuracy of spectral and temporal representativeness of air quality data by continuously reviewing the statewide air monitoring and sampling networks. Provides technical assistance and training to local air quality control districts in the areas of air monitoring instrument calibration and repair, air monitoring station siting and preparation of instrument purchase specifications.

The AQM-N Section Manager manages the AQM-N Section for the AQSB. The AQM-N Section is responsible for the operation of air monitoring stations in Northern California, specifically, the area between Sacramento and the Oregon border, and for the acceptance testing, maintenance and repair of all air monitoring and associated equipment used in the Statewide ARB air monitoring networks. Coordinates the collection and validation of ambient air quality data generated by air monitoring stations in his area of responsibility; the development of yearly calibration schedules for his section to be submitted to the manager of the SPM Section by December of each year; and the review of calibration reports and the tracking of instrument precision checks. Also provides his staff with the resources necessary to maintain yearly sampling schedules for gaseous analyzers, PM10, PM2.5, toxics, and TSP (lead) samplers. Coordinates the ordering, stocking and inventorying of all air monitoring equipment used by the section and will also track the repair and acceptance testing of air monitoring instrumentation, including the labor and material necessary to repair/acceptance test local district equipment so accurate invoices for services rendered can be issued. Responsibilities include:

< provides leadership to APSs in planning, designing, developing and implementation of all ARB ambient air quality monitoring projects and operations in Northern California

< manages, directs, oversees and coordinates the testing, maintenance, repair and fabrication of complex electronic micro-processer based ambient air monitoring, data acquisition, meteorological, calibration, toxic compound and particulate sampling instrumentation operated in the Statewide ARB, and eight (8) local agency air monitoring networks and the design, development testing and deployment of new sampling methods and technologies

< directs the repair of equipment for local air pollution control agencies and the invoicing of those agencies for the labor and material required

< oversees, manages and coordinates the acceptance testing of new, repaired and/or modified air monitoring instrumentation

< directs the evaluation testing of programs new instrumentation prior to purchase and oversees the development and drafting of the resulting evaluation reports

< stays current with newly developing air monitoring and general instrument technologies and participates in instrument design workshops and technical advisory work groups and develops instrument specifications as required

< provides leadership for APSs and Instrument Technicians in the purchase and testing of new equipment, the negotiation of contracts with local air pollution control agencies, other State agencies and landlords, the development of training workshops and courses on air monitoring instrumentation and the development and drafting of Quality Control (QC) and instrument operating procedures

- represents the MLD at meetings, conferences, working groups and forums that relate to ambient air monitoring issues throughout California as directed by the AQSB Chief

SPM Section Manager - Dennis Goodenow

This section supervises and coordinates the Special Purpose Monitoring Program which includes the mobile air monitoring stations (Rovers), the saturation sampling effort, and upper-air radar wind profilers. The section also operates the Air Quality Data Acquisition System (AQDAS), as well as fixed monitoring sites. Moreover it supports the ARB's control program by providing measurements to help define the nature, extent and trend of the air pollution problem.

Additionally, this section maintains the MLD's supply warehouse (Sacramento), including: tracking and ordering replacement parts (maintaining parts inventory); maintaining inventory on loaned equipment for billing purposes; providing shipping and receiving services, and maintaining the machine shop.

Management of the AQDAS includes coordination with AQDAS users, third level validation of ambient air quality data, and electronic data transfer to the U.S. EPA Aerometric Information Retrieval System (AIRS). The section coordinates site reports, maintains site information in AIRS, and acts as a repository for site reports.

The SPM Section Manager manages the AQDAS for the AQSB. Including coordinating with AQDAS users, third level data validation and electronic data transfer to the U.S. AIRS in a timely matter. Provides all training involving the operations of the AQDAS through his section.

Coordinates the collection and validation of reports; a branch-wide calibration schedule to be submitted to the ARB's Quality Assurance Section (QAS) by December of each year; the collection and retention of calibration reports and stripcharts; and the tracking of precision checks. Also develops yearly sampling schedules for PM10, PM2.5, dichots, toxics, NMOC and TSP (lead). Finally, the supervisor will coordinate the ordering, stocking and inventorying of all air monitoring equipment used by the branch. Responsibilities include:

- manages (plans, assigns, reviews and approves) the work of APSs, Air Resources Engineers (ARE) and Instrument Technicians in developing and executing special purpose air monitoring projects
- manages (plans, assigns, reviews and approves) the work of APS's, ARE's and technicians in the development and implementation of the AQDAS which includes design, development, deployment and testing the AQDAS and transmitting data to U.S. EPA in a timely manner
- becomes the branch expert on PM2.5; staying current on new technologies;

participating in network and instrument design; working with Region IX in statewide equipment and funding allocations; and other duties as assigned by the branch chief

- manage (plan, assign, review and approve) the work of APSs, AREs and technicians in the purchase, testing, training of personnel, development of QC procedures and operation of state-of-the-art instrumentation
- manages (plans, assigns, reviews and approves) the work of APSs and AREs in the development, design and preparation of performance specifications and testing protocols for a wide range of complex scientific instrumentation and their associated support systems
- oversees testing and assists in developing evaluation reports
- manages (plans, assigns, reviews and approves) the work of warehouse personnel in the procurement, storage and distribution of ambient air monitoring equipment, supplies and support equipment from the MLD's supply facility
- manages (plans, assigns, reviews and approves) the work of APSs, AREs and Instrument Technicians for the air monitoring site operations in Stockton, Jackson, San Andreas, Sonora, and 5-mile Learning Center

Field Personnel

Field personnel are responsible for the operation, maintenance, and repair of the PM2.5 samplers and for ensuring data quality results by adhering to the guidelines specified in the Manufacturer's Operation Manual and the Standard Operating Procedure (SOP). Detailed responsibilities include:

- participate in the development and implementation of the PM2.5 QAPP
- participate in training activities
- participate in the development of data quality requirements with appropriate QAS staff
- write and modify SOPs
- verify that all required QA activities are performed and that measurement quality standards are met as required in the QAPP
- follow all manufacturer's specifications
- ship filters to the laboratory for analysis
- perform and document monthly sampler checks as indicated in the SOP
- calibrate samplers as indicated in the SOP
- document all repairs and maintenance performed
- report any problems to appropriate personnel
- document deviations from established procedures and methods
- assess and report data quality
- prepare and deliver reports to management
- flag suspect data
- prepare and deliver data to the SPM Manager
- respond to audit results if necessary

Acceptance Test Personnel

Acceptance test personnel are responsible for developing and implementing acceptance test procedures by adhering to U.S. EPA regulations and guidelines and the Manufacturer's Operation Manual and SOPs. Responsibilities include:

- develop acceptance test SOPs
- obtain samplers from shipping/receiving
- inspect samplers prior to acceptance testing
- conduct acceptance tests
- prepare appropriate acceptance test documentation
- return samplers to shipping/receiving for deployment

Shipping/Receiving Personnel

Shipping/receiving personnel provide support for all shipping/receiving of all equipment and consumable supplies for the PM2.5 Ambient Air Monitoring Program. Responsibilities include:

- inform appropriate staff of arrival of consumables and equipment
- store spare parts
- document, track, and archive shipping/receiving records

QMB Chief - Jeff Cook

Conducts and reviews quality assurance, quality assessment, and quality control activities for programs undertaken within MLD and the local districts to ensure ambient air quality data and speciated motor vehicle data meet or exceed the data quality objectives of the end user.

Develops and manages projects of the Quality Assurance (QA) and Program Evaluation and Standards (PE&S) Sections that accomplish the mission of the QMB and supports other Branches in MLD. Plans future activities with MLD managers. Coordinates plans with other divisions, districts, and the U.S. EPA. Responsibilities include:

- plans, directs, and reviews projects for the QA Section
- provides direction on new initiatives and develops new audit programs to meet new monitoring activities
- works to ensure adequate equipment and personnel resources are available to meet regulatory audit requirements
- plans, directs and reviews activities of the PE&S Section
- reviews, recommends and approves projects, reports, and abstracts developed by and for the PE&S Section

- presents, along with staff, key findings related to measurement practices and reports on emerging issues/problems related to changing methods and practices; ensures adequate review given to quality control reports and quality assurance manuals
- maintains National Institute of Standards and Technology (NIST) contract and provides the QA Section and labs with high quality calibration and audit gases pertaining to QMB and MLD activities
- assists developing, planning and implementing new activities relating to the MLD
- coordinates with other divisions and the U.S. EPA to facilitate agreements on new monitoring initiatives
- coordinates with the PTSD to facilitate Memorandum of Understanding (MOU) agreements with local air quality districts to ensure the quality of data being reported
- prepares documents, comment letters, and recommendations for the MLD chief as requested
- participates in MLD policy development, and carries out ARB and MLD directives relating to personnel, safety, conduct, and staff performance
- represents MLD at Standing Air Monitoring Working Group and Environmental Technology Verification Stakeholders Working Group

PE&S Section Manager - Cliff Popejoy

The PE&S Section is responsible for evaluating the quality assurance and quality control programs to ensure the highest quality data that is feasible, assessing the acceptability of the air quality data prior to its use in the regulatory process, developing and implementing tighter quality control measures at the point of data generation, purchasing NIST standards, and certifying gases and flow standards used in the field.

The incumbent, under the direction of the QMB Branch Chief, serves as the supervisor of the PE&S Section. The person is responsible for planning, organizing and supervising the activities of the Section. Responsibilities include:

- plans, organizes, and reviews and directs activities of the PE&S Section
- develops and maintains project plans for review with management
- recommends policy and implements policy direction
- develops future year plans and equipment budgets
- prepares and manages service contracts for standards development
- reviews and approves reports, attends management meetings and coordinates with other divisions

QA Section Manager - Mike Miguel

The QA Section is responsible for the precision and accuracy of all data generated and collected by the State, local and private air monitoring agencies in the California air monitoring network. This position serves as one of the many aspects in assuring that the data are in compliance with the criteria set by Federal and State Clean Air Acts. These responsibilities are carried out by conducting field and laboratory performance and system audits, issuing Air Quality Data Action requests on instruments that fail, evaluating air monitoring sites, preparing the Quality Assurance procedures manual and issuing reports on audit results.

The incumbent plans, organizes, and directs the section staff; interprets policy, develops policy procedures; and handles personnel issues. Responsibilities include:

- maintains the PM2.5 QAPP
- plans, organizes, and supervises the activities outlined above
- reviews and approves reports
- attends management meetings
- coordinates audit activities with U.S. EPA, districts, and other divisions within the ARB
- ensures conformance with U.S. EPA requirements
- recommends policy and implements policy direction
- develops project plans and equipment budgets

Standards Laboratory Personnel

Standards Laboratory personnel are responsible for conducting gas standards analyses, calibrations and certifications, and preparing appropriate reports by adhering to the manufacturer’s operation manual, U.S. EPA’s regulations and guidelines, and to SOPs. Responsibilities include:

- administer the gas standards analyses program
- perform calibrations of ozone transfer standards; electronic measurement and flow control transfer standards; orifice-type transfer standards for ARB, local air quality districts and other states in the U.S. EPA, Regions IX and X; and prepare certification reports for the above transfer standards
- perform scheduled maintenance of the primary ozone and flow measurement standards and coordinate work with NIST and other quality control agencies to ensure accuracy and repeatability of the primary standards
- compose and review calibration and certification reports for all standards that are certified for State, local, and private agencies
- enhance the scope of and maintaining the complex gas certification assay system
- write laboratory procedures for the Standards Certification program

QA Personnel

QA personnel are responsible for conducting system and performance audits for the PM2.5 program by adhering to U.S. EPA regulations and guidelines and SOPs. Responsibilities include:

- coordinate the development of a PM2.5 QAPP
- develop and implement the PM2.5 Laboratory Operations Precertification Program
- participate in training activities
- participate in the development of data quality requirements
- conduct quality assurance performance and system audits for the criteria pollutant program and prepare and issue appropriate reports and findings
- develop quality assurance SOPs and methodologies
- verify that all required QA activities were performed as required in the QAPP
- review air monitoring station site reports for compliance with State and federal siting criteria
- analyze and evaluate ambient air quality data and make recommendations regarding its quality and accuracy

NLB Chief - Mike Poore

The NLB supports the ARB ambient air monitoring program by developing laboratory and field test procedures, analyzing ambient air samples, and providing technical assistance to the districts and others active in air pollution programs.

Under general direction of the MLD Chief, the NLB Chief performs the following duties in managing, planning, organizing, and directing the PM2.5 activities of the NLB:

- analyzes ambient air samples for inorganic species
- develops laboratory analytical methods
- conducts special studies to determine feasibility of new or alternate sampling and laboratory procedures
- provides laboratory services to support other ARB divisions and other sections for the NLB
- reviews quarterly QC reports

ILS Manager - Vacant

ILS is responsible for analyzing ambient air samples from monitoring sites located throughout California for inorganic species. The section also develops laboratory analytical methods and conducts special studies to determine the feasibility of new or alternate sampling and analytical methods and to support the other activities of the MLD and ARB.

Under general direction of the NLB Chief, the ILS Manager supervises, plans, evaluates, coordinates and directs the activities of the ILS. Responsibilities include:

- directs and supervises the operations of the ILS to ensure that analyses of ambient air samples collected throughout California are performed properly and in a timely manner.

- plans, designs, manages and coordinates long-range pilot studies to initiate, improve and automate analytical test procedures and field data sampling systems
- directs special studies to support other activities of the NLB and recommends methods and procedures to improve the precision, accuracy, and detection of specific compounds or air pollutants at very low concentration levels
- implements laboratory production and quality control monitoring systems and takes corrective action as required
- reviews and edits all data releases, reports and correspondence
- coordinates activities of the ILS with other ARB divisions and government agencies

Laboratory Personnel

Laboratory personnel are responsible for carrying out required tasks and ensuring the data quality result of the tasks by adhering to guidance and protocol specified by the PM2.5 QAPP and SOPs for the lab activities. Responsibilities include:

- participate in the development and implementation of the QAPP
- participate in training activities
- participate in the development of data quality requirements (overall and laboratory) with the appropriate QA staff
- write and modify SOPs and good laboratory practices (GLP)
- verify that all required QA activities were performed and that measurement quality standards were met as required in the QAPP
- follow all manufacturer's specifications
- perform and document preventative maintenance
- document deviations from established procedures and methods
- report all problems and corrective actions to management
- assess and report data quality
- prepare and deliver reports to management
- flag suspect data

Information Management Personnel

Information management personnel are responsible for coordinating the information management activities of the PM2.5 Ambient Air Monitoring Program. The main responsibilities of the information management personnel include ensuring that data and information collected for the PM2.5 Monitoring Program are properly captured, stored, and transmitted for use by program participants. Responsibilities include:

- develop local data management standard operating procedures
- ensure that information management activities are developed within reasonable time frames for review and approval
- follow good automated data processes

- coordinate the development of the information management system with data users
- ensure the development of data standards for data structure, entry , transfer, and archive
- ensure adherence to the QAPP where applicable
- ensure access to data for timely reporting and interpretation processes
- prepare and deliver data to the ARB's PTSD
- ensure timely delivery of all required data to the U.S. EPA's AIRS system

Y.4.1.3.3 PLANNING AND TECHNICAL SUPPORT DIVISION (PTSD)

PTSD's primary mission is to provide support to other ARB divisions and to districts in the technical aspects of the air pollution control program. The PTSD is also responsible for developing new techniques for air quality modeling, data processing, emission inventories, and air quality data analysis.

PTSD Chief - Bob Fletcher

Under the direction of the Executive Office, manages the PTSD and its staff to provide a sound technical and scientific basis for the State's Air Resources Management Program by providing reliable data and with advanced tools to interpret those data to support the establishment of cost-effective regulatory programs. Responsibilities include:

- plans, organizes, and directs the work of the PTSD
- anticipates and positions the PTSD to respond to the ARB's future needs for technical support
- provides administrative direction, program leadership, and technical oversight to the PTSD's activities and staff
- serves as a member of the ARB's Executive Staff
- participates in strategy formulation
- renders recommendations related to the PTSD's areas of responsibility
- helps with policy development
- represents the ARB and the Executive Office with stakeholders including other government agencies, the regulated community, and the public

AQDB Chief - Bob Effa

The Air Quality Data Branch (AQDB) compiles and publishes California's Ambient Air Quality Data. It maintains a computerized database containing the data and develops systems and processes for distributing these data in electronic form. The AQDB also identifies areas attaining and not attaining the State Ambient Air Quality Standards and evaluates air quality trends and develops tools for determining and presenting these trends. Additionally, the AQDB analyzes and interprets air quality data in the context of meteorological and emission data to explain the causes and mechanisms responsible for the State's air quality problems. Responsibilities include:

- supervises section managers
- plans, organizes, budgets, and schedules AQDB activities
- reviews and edits AQDB reports, publications, and correspondence
- coordinates client support activities with other ARB sections
- coordinates with MLD to facilitate MOU agreements with local air quality districts to ensure the quality of data being reported
- prepares and presents special reports
- provides consultation, data evaluation, and testimony to the ARB, Executive Office, Governor's Office and to others upon request
- assists PTSD Chief and Assistant PTSD chief in planning, organizing, budgeting, and implementing PTSD's programs

AQDR Manager - Ron Rothacker

The Air Quality Data Review (AQDR) Section's primary duty is to carefully manage, archive, and distribute the ambient aerometric data collected on behalf of the State of California's air quality management programs. Specific activities include resolving discrepancies in data, providing for the orderly and efficient transfer of data from data suppliers to the database, and distributing the data to meet customer needs. Further specific duties include the development and implementation of enhancements to the data management systems and to the forms of data distribution and access used to perform the above, and the evaluation of siting issues, including annual network reviews for PM2.5 and other aerometric parameters. Responsibilities include:

- supervises and directs AQDR Section staff in the development of air quality data management systems and data distribution methods
- plans, organizes, budgets, and schedules activities for the AQDR Section
- coordinates air quality data submittals and requests, and monitoring network activities with other ARB sections, local air pollution control districts, U.S. EPA, and other federal agencies
- supervises and directs AQDR Section staff in collecting, reviewing, managing, and distributing air quality data
- prepares responses to legislative, public, and media inquiries regarding topics such as current air quality in specific areas and progress in achieving ambient air quality standards
- assists PTSD and AQDB Chiefs in planning, organizing, budgeting, and implementing PTSD programs

Air Quality Data Review Personnel

Air Quality Data Review personnel receive, review, and transfer ambient air quality data, and prepare appropriate reports and network reviews. Responsibilities include:

- develop the sampling design for PM2.5
- review data received from various sources and transfer the data into the State database
- submit the annual data certification letter and episode reports letter to U.S. EPA, Region IX
- conduct an annual SLAMS network review

Y.4.1.4 CALIFORNIA AIR DISTRICTS

By legislative mandate, the arb has oversight of California's air pollution control program with responsibility for improving and maintaining the air quality in the state. In the state of California, there are four reporting organizations for federal purposes. These reporting organizations are: 1) California ARB , 2) Bay Area Air Quality Management District (AQMD), 3) San Diego County Air Pollution Control District (APCD), and 4) South Coast AQMD. Several other air districts in California have been delegated the authority to directly submit data to the U.S. EPA AIRS database. A major responsibility of the ARB is the implementation of a satisfactory air monitoring program, which includes the implementation of an appropriate quality assurance program in partnership with the California air districts. It is the responsibility of the state and local agencies to implement quality assurance programs in all phases of the air monitoring network, including the field, their own laboratories, and in any consulting and contractor laboratories which they may use to obtain data. The network operations are defined as work performed to obtain, use, or report information pertaining to environmental processes or conditions.

Each reporting organization shall be defined such that precision and accuracy among all stations in the organization can be expected to be reasonably homogeneous as a result of common factors. Common factors include: 1) operation by a common team of field operators, 2) common calibration facilities, and 3) support by a common laboratory or headquarters.

The arb reporting organization consists of arb and all air pollution control districts in the State of California, except the Bay Area AQMD, San Diego County APCD, and South Coast AQMD.

Each reporting organization shall be responsible for maintaining their own quality assurance programs and reporting their precision and accuracy data to the U.S. EPA. Each agency's QAPP will be reviewed and approved by the U.S. EPA. In order to ensure data continuity between reporting organizations, the arb conducts periodic system audits and performance audits.

Y.5.0 ELEMENT 5 - PROBLEM DEFINITION/BACKGROUND

Y.5.1 PROBLEM STATEMENT AND BACKGROUND

Between the years 1900 and 1970, the emission of six principal ambient air pollutants increased significantly. The principal pollutants, also called criteria pollutants, are: particulate matter (PM10, PM2.5), sulfur dioxide, carbon monoxide, nitrogen dioxide, ozone, and lead. In 1969, the first State Ambient Air Quality Standards are promulgated by California for total suspended particulates, photochemical oxidents, sulfur dioxide, nitrogen dioxide, and carbon monoxide. In 1970, the Federal Clean Air Act (CAA) was signed into law. The CAA and its amendments provides the framework for all pertinent organizations to protect air quality. This framework provides for the monitoring of these criteria pollutants by State and local organizations through the Air Quality Monitoring Program.

The criteria pollutant defined as particulate matter is a general term used to describe a broad class of substances that exist as liquid or solid particles over a wide range of sizes. As part of the Ambient Air Quality Monitoring Program, U.S. EPA will measure two particle size fractions; those less than or equal to 10 micrometers (PM10), and those less than or equal to 2.5 micrometers (PM2.5). This QAPP focuses on the QA activities associated with PM2.5.

The background and rationale for the implementation of the PM2.5 ambient air monitoring network can be found in the Federal Register. In general, some of the findings are listed below.

The characteristics, sources, and potential health effects of larger or "coarse" particles (from 2.5 to 10 micrometers (mm) in diameter) and smaller or “fine" particles (smaller than 2.5 mm in diameter) are very different.

- Coarse particles come from sources such as windblown dust from the desert or agricultural fields and dust kicked up on unpaved roads from vehicle traffic.

- Fine particles are generally emitted from activities such as industrial and residential combustion and from vehicle exhaust. Fine particles are also formed in the atmosphere from gases such as sulfur dioxide, nitrogen oxides, and volatile organic compounds that are emitted from combustion activities and then become particles as a result of chemical transformations in the air.

- Coarse particles can deposit in the respiratory system and contribute to health effects such as aggravation of asthma. U.S. EPA's "staff paper" concludes that fine particles, which also deposit deeply in the lungs, are more likely than coarse particles to contribute to the health effects (e.g., premature mortality and hospital admissions) found in a number of recently published community epidemiological studies.

- These recent community studies find that adverse public health effects are associated with exposure to particles at levels well below the current PM standards for both short-term (e.g., less than 1 day to up to 5 days) and long-term (generally a year to several years) periods.

- These health effects include premature death and increased hospital admissions and emergency room visits (primarily among the elderly and individuals with cardiopulmonary disease); increased respiratory symptoms and disease (among children and individuals with cardiopulmonary disease such as asthma); decreased lung function (particularly in children and individuals with asthma); and alterations in lung tissue and structure and in respiratory tract defense mechanisms.

Air quality samples are generally collected for one or more of the following purposes:

1. To judge compliance with and/or progress made towards meeting the National Ambient Air Quality Standards and the California Ambient Air Quality Standards,
2. To develop, modify or activate control strategies that prevent or alleviate air pollution episodes,
3. To observe pollution trends throughout the region, including non-urban areas,
4. To provide a data base for research and evaluation of effects.

With the end use of the air quality samples as a prime consideration, various networks can be designed to meet one of six basic monitoring objectives listed below:

- Determine the highest concentrations to occur in the area covered by the network
- Determine representative concentrations in areas of high population density
- Determine the impact on ambient pollution levels of significant source or source categories
- Determine general background concentration levels
- Determine the extent of Regional pollutant transport among populated areas, and in support of secondary standards
- Determine the welfare-related impacts in more rural and remote areas

The monitoring network consists of four major categories of monitoring stations that measure the criteria pollutants, including PM2.5. These stations are described below.

The **SLAMS** consist of a network of ~ 3,500 monitoring stations whose size and distribution is largely determined by the needs of State and local air pollution control agencies to meet their respective SIP requirements. There will be 89 SLAMS PM2.5 sites in California.

The National Air Monitoring Stations (**NAMS)** (~1,080 stations) are a subset of the SLAMS network with emphasis being given to urban and multi-source areas. In effect, they are key sites under SLAMS, with emphasis on areas of maximum concentrations and high population density.

The Photochemical Assessment Monitoring Stations (**PAMS**) network is required to measure ozone precursors in each ozone non-attainment area that is designated serious, severe, or extreme. The required networks will have from 2 to 5 sites, depending on the population of the area. There is a phase-in period of 1 site per year starting in 1994. The ultimate PAMS network could exceed 90 sites at the end of the 5-year phase-in period. It is anticipated that there will be PM2.5 monitors located at 7 PAMS sites in California.

Special Purpose Monitoring Stations (SPMS) provide for special studies needed by the State and local agencies to support their SIPs and other air program activities. The SPMS are not permanently established and, thus, can be adjusted easily to accommodate changing needs and priorities. The SPMS are used to supplement the fixed monitoring network as circumstances require and resources permit. If the data from SPMS are used for SIP purposes, they must meet all QA and methodology requirements for SLAMS monitoring. SPMS have not yet been identified in California, though it is anticipated that there will be 37 speciation samplers operating in the statewide network.

This QAPP focuses only on the QA activities of the SLAMS and NAMS network and the objectives of this network which include any sampler used for comparison to the National Ambient Air Quality Standards (NAAQS).

Throughout this document, the term *decision maker* will be used. This term represents individuals that are the ultimate users of ambient air data and therefore may be responsible for activities such as setting and making comparisons to the NAAQS, and evaluating trends. Since there is more than one objective for this data, and more than one decision maker, the quality of the data (see Element 7) will be based on the highest priority objective, which was identified as the determination of violations of the NAAQS. This QAPP will describe the how the ARB PM2.5 Ambient Air Quality Monitoring Program intends to control and evaluate data quality to meet the NAAQS data quality objective.

Y.6.0 ELEMENT 6 - PROJECT/TASK DESCRIPTION

Y.6.1 DESCRIPTION OF WORK TO BE PERFORMED

In general, the measurement goal of the PM2.5 Ambient Air Quality Monitoring Program is to estimate the concentration, in units of micrograms per cubic meter (Fg/m^3), of particulates less than or equal to 2.5 micrometers (Fm) that have been collected on a 46.2mm polytetrafluoroethylene (PTFE) filter. For the SLAMS/NAMS network, which is what this QAPP describes, the primary goal is to compare the PM2.5 concentrations to the annual and 24-hour National Ambient Air Quality Standard (NAAQS). The national primary and secondary ambient air quality standards for PM2.5 are 15.0 micrograms per cubic meter (Fg/m^3) annual arithmetic mean concentration and 65 Fg/m^3 24-hour average concentration measured in ambient air. A description of the NAAQS and its calculation can be found in the 1997 Federal Register[1] Notice. In addition, Appendix L of part 50 also provides the following summary of the measurement principle:

> " An electrically powered air sampler draws ambient air at a constant volumetric flow rate into a specially shaped inlet and through an inertial particle size separator (impactor) where the suspended particulate matter in the PM2.5 size range is separated for collection on a polytetrafluoroethylene (PTFE) filter over the specified sampling period. The air sampler and other aspects of this reference method are specified either explicitly in this appendix or generally with reference to other applicable regulations or quality assurance guidance.
>
> Each filter is weighed (after moisture and temperature equilibration) before and after sample collection to determine the net weight (mass) gain due to collected PM2.5. The total volume of air sampled is determined by the sampler from the measured flow rate at actual ambient temperature and pressure and the sampling time. The mass concentration of PM2.5 in the ambient air is computed as the total mass of collected particles in the PM2.5 size range divided by the actual volume of air sampled, and is expressed in micrograms per actual cubic meter of air (Fg/m^3)."

The following sections will describe the measurements required for the routine field and laboratory activities for the network. In addition to these measurements, an initial set of measurements will be required to fulfill the requirements of the AIRS data base.

Y.6.2 FIELD ACTIVITIES

The performance requirements of the air sampler has been specified in Part 50, Appendix L of the 7/18/97 Federal Register Notice[1] . Table Y.6.0.1 summarizes some of the more critical performance requirements.

Table Y.6.0.1
Design/Performance Specifications

Equipment	Acceptance Criteria	Reference
Filter Design Specs.	see reference	40 CFR Pt. 50, App.L Sec
Size	46.2 mm dia ± 0.25mm	6.0
Medium	Polytetrafluoroethylene	" Sec 6.1
Support ring	Polymethylpentene	" Sec 6.2
	0.38mm thick	" Sec 6.3
	46.2 mm ± 0.25mm outer dia.	"
	3.68 (±0.00, -0.51mm) width	"
Pore size	2 Fm	"
Filter thickness	30-50 Fm	"Sec 6.4
Max. pressure drop	30 cm H_2O @ 16.67L/min	"Sec 6.5
Max. Moisture pickup	10 Fg increase in 24 hr.	"Sec 6.6
Collection efficiency	99.7%	"Sec 6.7
Filter weight stability	<20 Fg	"Sec 6.8
Alkalinity	< 25.0 microequivalents/gram	"Sec 6.9.1 and 6.9.2
		"Sec 6.10
Sampler Performance Specs.		
Sample Flow Rate	1.000 m^3/hr.	40 CFR Pt. 50, App.L Sec7.4
Flow Regulation	1.000 ± 5% m^3/hr.	"
Flow Rate Precision	2% CV	
Flow Rate Accuracy	±2%	"
External Leakage	<80mL/min	"
Internal Leakage	<80mL/min	"
Ambient Temp Sensor	-30° - + 45° C	Vol-II -MS. 2.12
	0.1° C res. ±2.0°C accuracy	40 CFR Pt. 50, App.L Sec7.4
Filter Temp Sensor	-30° - +45° C	"
	0.1° C res. ±1.0°C accuracy	
Barometric Pressure	600-800 mm Hg	"
	5 mm res. ±10mm accuracy	
Clock/Timer	Date/time.	"
	1 sec. res. ± 1 min/month accuracy	

The air samplers will be purchased, distributed, and certified by the U.S. EPA as meeting the requirements specified in the Federal Register. Therefore, the ARB assumes the sampling instruments to be adequate for the sampling for PM2.5. Other than the required federal reference or equivalent air sampler, there are no special personnel or equipment requirements. Element 15 lists all the equipment requirements for the ARB PM2.5 data collection operations.

Y.6.2.1 FIELD MEASUREMENTS

Table Y.6.0.2 represents the field measurements that must be collected. This table is presented in the Federal Register[1] as Table L-1 of Appendix L. These measurements are made by the air sampler and are stored in the instrument for downloading by the field operator during routine visits.

Table Y.6.0.2
Field Measurement Requirements

Information to be provided	Appendix L section reference	Availability				Format	
		Anytime*	End of period[b]	Visual display[c]	Data output[d]	Digital reading[e]	Units
Flow rate, 30-second maximum interval	7.4.5.1	U	—	U	r	XX.X	L/min
Flow rate, average for the sample period	7.4.5.2	r	U	r	U	XX.X	L/min
Flow rate, CV, for the sample period	7.4.5.2	r	U	r	U Ž	XX.X	%
Flow rate, 5-min average out of spec. (FLAG)[f]	7.4.5.2	U	U	U	U Ž	On/Off	
Sample volume, total	7.4.5.2	r	U	U	U Ž	XX.X	m^3
Temperature, ambient, 30-second interval	7.4.8	U	—	U	—	XX.X	EC
Temperature, ambient, min., max., average for the sample period	7.4.8	r	U	U	U Ž	XX.X	EC
Barometric pressure, ambient, 30-second interval	7.4.9	U	—	U	—	XXX	mm Hg
Barometric pressure, ambient, min., max., average for the sample period	7.4.9	r	U	U	U Ž	XXX	mm Hg
Filter temperature, 30-second interval	7.4.11	U	—	U	—	XX.X	EC
Filter temperature, differential, 30-minute interval, out of spec. (FLAG)[f]	7.4.11	r	U	U	U Ž	On/Off	
Filter temperature, maximum differential from ambient, date, time of occurrence	7.4.11	r	r	r	r	X.X, YY/MM/DD HH:mm	EC, Yr/Mo/ Day Hr min
Date and time	7.4.12	U	—	U	—	YY/MM/DD HH:mm	Yr/Mo/ Day Hr min
Sample start and stop time settings	7.4.12	U	U	U	U	YY/MM/DD HH:mm	Yr/Mo/ Day Hr min
Sample period start time	7.4.12	—	U	U	U Ž	YYYY/MMM/DD HH:mm	Yr/Mo/ Day Hr min
Elapsed sample time	7.4.13	r	U	U	U Ž	HH:mm	Hr min
Elapsed sample time out of spec. (FLAG)[f]	7.4.13	—	U	U	U Ž	On/Off	
Power interruptions >1 min, start time of first 10	7.4.15.5	r	U	r	U	1HH:mm, 2HH:mm, etc.	Hr min
User-entered information, such as sampler and site identification	7.4.16	U	U	U	U Ž	As entered	

U Provision of this information is required.

r Provision of this information is optional. If information related to the entire sample period is optionally provided prior to the end of the sample period, the value provided should be the value calculated for the portion of the sampler period, completed up to the time the information is provided.

Ž Indicates that this information is also required to be provided to the AIRS data bank.

[a] Information is required to be available to the operator at any time the sampler is operating, whether sampling or not.

[b] Information relates to the entire sampler period and must be provided following the end of the sample period until reset manually by the operator or automatically by the sampler upon the start of a new sample period.

[c] Information shall be available to the operator visually.

[d] Information is to be available as digital data at the sampler's data output port following the end of the sample period until reset manually by the operator or automatically by the sampler upon the start of a new sample period.

[e] Digital readings, both visual and data output, shall have no less than the number of significant digits and resolution specified.

[f] Flag warnings may be displayed to the operator by a single-flag indicator or each flag may be displayed individually. Only a set (on) flag warning must be indicated; an off (unset) flag may be indicated by the absence of a flag warning. Sampler users should refer to Section 10.12 of Appendix L regarding the validity of samples for which the sampler provided an associated flag warning.

In addition to the measurements collected in Table Y.6.0.2, the following information identified in Table Y.6.0.3 will be recorded. These parameters are explained in *Guidance Document 2.12*[2]

Table Y.6.0.3
Additional Field Measurements

Parameter	Parameter Code	Frequency	Units	Comment
Monitor ID	MONID	Every sample event	see AIRS	Unique AIRS Monitor ID that include the combination of STATE, COUNTY, SITE, PARAMETER, and POC fields
Site Name	SITENAM	Every sample event	AAA...	Unique site name associated with the site
Sampler ID	SAMPID	Every sample event	AAXXX	Sampler model number or unique bar code number associated with the model number
QC Thermometer ID Initial	QCTIDI	Every sample event	AAAXXX	Unique ID number of QC thermometer used for ambient air temp check at the beginning of sampling
QC Temperature Measurement Initial	QCTEMPI	Every sample event	XX°C	QC temp reading at the beginning of sampling

Table Y.6.0.3
Additional Field Measurements (cont.)

QC Baromter ID Initial	QCBIDI	Every sample event	AAAXXX	Unique alpha-numeric ID of QC barometric pressure device used for barometric pressure reading check
QC Bar. Pressure Reading Initial	QCBI	Every sample event	XXX mm Hg	QC temp reading at the beginning of sampling
QC Thermometer ID Final	QCTIDF	Every sample event	AAAXXX	Unique ID number of QC thermometer used for ambient air temp check at the beginning of sampling
QC Temperature Measurement Final	QCTEMPF	Every sample event	XX°C	QC temp reading at the end of sampling
QC Baromter ID Final	QCBIDF	Every sample event	AAAXXX	Unique alpha-numeric ID of QC barometric pressure device used for barometric pressure reading check
QC Bar. Pressure Reading Final	QCBF	Every sample event	XXX mm Hg	QC temp reading at the end of sampling
Filter ID	FID	Every sample event	AAYYXXXX	Unique filter ID of filter given by the weighing laboratory.
Filter Integrity flag	FFIF	Every sample event		VFI- Void Filter Integrity GFI-Good Filter Integrity
Site Operator Initial	SOI	Every sample event	AAA	Initials of the site operator setting up the sampling run
Site Operator Final	SOF	Every sample event	AAA	Initials of the site operator completing the sampling run
Free Form Notes	FFM	As needed	AAA....	Free form notes about the sampling run

Note: "AAA" denotes an alphabetic character and "XXX" denotes a numeric character.

Y.6.3 LABORATORY ACTIVITIES

Laboratory activities for the PM2.5 program include preparing the filters for the routine field operator, which includes three general phases:

Pre-Sampling weighing

< Receiving filters from the U.S. EPA
< Checking filter integrity
< Conditioning filters
< Weighing filters
< Storing prior to field use
< Packaging filters for field use
< Associated QA/QC activities

- Maintaining microbalance at specified environmental conditions
- Equipment maintenance and calibrations

Shipping/Receiving

- Receiving filters from the field and logging these in
- Storing filters
- Associated QA/QC activities (see Element 12)

Post-Sampling Weighing

- Checking filter integrity
- Stabilizing/weighing filters
- Data downloads from field data loggers
- Data entry/upload to AIRS
- Storing filters/archiving
- Associated QA/QC activities

The details for these activities are included in various 3Elements of this document as well as *Guidance Document 2.12*[2]. TableY.6.0.4 provides the performance specifications of the laboratory environment and equipment.

Table Y.6.0.4
Laboratory Performance Specifications

Equipment	Acceptance Criteria
Microbalance	Resolution of 1 µg, repeatability of 1 µg
Microbalance environment	Climate-controlled, draft-free room or chamber or equivalent, stable work surface. Mean relative humidity between 30 and 40 percent, with a variability of not more than ±5 percent standard deviation over 24 hours. Mean temperature should be held between 20 and 23 EC, with a variability of not more than ±2 EC standard deviation over 24 hours.
Mass reference standards	Standards up to 200 mg*, individual standard's tolerance less than 25 µg, handle with smooth, nonmetallic forceps

* For the following three reasons, the multipoint calibration for this method will be zero, 100 and 200 mg: 1) the required sample collection filters weigh between 100 and 200 mg; 2) the anticipated range of sample loadings for the 24-hour sample period is rarely going to be more than a few 100 Fg; and 3) the lowest, commercially available check weights that are certified according to nationally accepted standards are only in the single milligram range. Since the critical weight is not the absolute unloaded or loaded filter weight, but the difference between the two, the lack of microgram standard check weights is not considered cause for concern about data quality, as long as proper weighing procedure precautions are taken for controlling contamination or other sources of mass variation in the procedure (see SOP in Appendix B).

Y.6.3.1 LABORATORY MEASUREMENTS

With the exception of the shipping/receiving, which is discussed in detail in Element 12, Table Y.7.0.5 lists the parameters that will be required to be recorded for pre and postsampling weighing laboratory activities.

Table Y.6.0.5
Laboratory Measurements

Parameter	Frequency	Units	Comments
Filter Conditioning[1] Start Date	every filter	YY/MM/DD	Date of start of conditioning period
Start Time	every filter	XX.XX	Start hour and minute of conditioning
Filter Number	every filter	RFYYXXXX LBYYXXXX FBYYXXXX	Unique filter ID of routine filter (RF) Lab Blanks (LB) Field Blanks (FB)
Relative Humidity	continuous	XX%	% relative humidity value for conditioning session based upon readings of continuous chart recorder
Temperature	continuous	XX°C	temperature value for conditioning session based upon readings of continuous chart recorder
End Date	every filter	YY/MM/DD	Date of start of conditioning period
End Time	every filter	XX.XX	End hour and minute of conditioning
Presampling Filter Weighing Date	every filter	YY/MM/DD	Date for presampling run of filters that can then be associated with each filter
Filter Lot Number	every filter	AAAXXX	Lot number associated with filter
Balance Number	every filter	AAAXXX	Unique balance ID for balance used in pre-weighing
Analyst	every filter	AAA	Initials of the technician preweighing filters
Relative Humidity	continuous	XX%	% relative humidity value for weighing session based upon readings of continuous chart recorder
Temperature	continuous	XX°C	temperature value for weighing session based upon readings of continuous chart recorder

Table Y.6.0.5
Laboratory Measurements (cont.)

Parameter	**Frequency**	**Units**	**Comments**
Filter Number	every filter	RFYYXXXX LBYYXXXX FBYYXXXX FCYYXXXX DFYYXXXX	Unique filter ID of routine filter (RF) Lab Blanks (LB) Field Blanks (FB) Flow Check Filter (FC) and Duplicate Filter (DF)
QC Sample Number	every QC check	C1XXX C2XXX C3XXX	Unique ID for calibration checks and or other types of QC samples used
Presampling Mass	every filter	XXX.XXX mg	Mass weight in mg of the filter
Monitor ID[2]	Every sample	see AIRS	Unique AIRS Monitor ID that include the combination of STATE, COUNTY, SITE, PARAMETER, and POC fields
Free Form Notes	As needed	AAA...	Preweighing Free Form notes
Postsampling Filter Weighing Date	every filter	YY/MM/DD	Date for postsampling run of filters that can then be associated with each filter
Balance Number	every filter	AAAXXX	Unique balance ID for balance used in postweighing
Analyst	every filter	AAA	Initials of the technician postweighing filters
Relative Humidity	continuous	XX%	% relative humidity value for weighing period based upon readings of continuous chart recorder
Temperature	continuous	XX°C	temperature value for weighing period based upon readings of continuous chart recorder
Filter Number	every filter	RFYYXXXX LBYYXXXX FBYYXXXX DFYYXXXX	Unique filter ID of routine filter (RF) Lab Blanks (LB) Field Blanks (FB) and Duplicate Filter (DF)
QC Sample Number	every QC check	C1XXX C2XXX C3XXX	Unique id for calibration checks and or other types of QC samples used
Postsampling Mass	every filter	XXX.XXX mg	Mass weight in mg of the filter
Net Mass	every filter	XXX.XXX mg	Net weight (Postsampling Mass - presampling Mass) - in mg of PM2.5
Free Form Notes	as needed	AAA...	Postweighing free form notes

Note: For units, “AAA”, denotes an alphabetic character and “XXX” denotes a numeric character.

1- Environmental conditions (relative humidity and temperature) in the laboratory will be continuously recorded. Pre- and postweighing of filters will only occur after compliance with specified environmental limits during filter conditioning and weighing periods is verified.

2- The Monitor ID may be assigned at sampling rather than pre-assigned during presampling weighing.

Y.6.4 PROJECT ASSESSMENT TECHNIQUES

An assessment is an evaluation process used to measure the performance or effectiveness of a system and its elements. As used here, assessment is an all-inclusive term used to denote any of the following: audit, performance evaluation (PE), management systems review (MSR), peer review, inspection, or surveillance. Definitions for each of these activities can be found in the glossary (Appendix A). Element 20 will discuss the details of the ARB's assessments.

Table Y.6.0.6 provides information on the parties implementing the assessment and their frequency.

Table Y.6.0.6
Assessment Schedule

Assessment Type	**Assessment Agency**	**Frequency**
System Audit	U.S. EPA Regional Office ARB's QA Section	1 every 3 years 1st year*
Network Review	U.S. EPA Regional Office, and Planning and Technical Support Division	every year 1/year
FRM Performance Evaluation	U.S. EPA Regional Office	25% of sites/year/4 times per year.
Data Quality Assessment	ARB'S QA Section, and Planning and Technical Support Division	every year

***Note:** ARB's Quality Assurance Section (QAS) will precertify all PM2.5 laboratories which is a condition for submittal of PM2.5 data to the U.S. EPA's AIRS. The QAS will conduct system audits of laboratories during their first year of operation following precertification. Additionally, they will conduct annual PM2.5 laboratory performance audits of the microbalances and relative humidity and temperature sensors and will review the laboratories' quarterly QC Reports. If problems are identified during the laboratory performance audits and with the QC reports, additional system audits will be scheduled.

Y.6.5 SCHEDULE OF ACTIVITIES

Table Y.6.0.7 contains a list of the critical activities required to plan, implement, and assess the PM2.5 program.

Table Y.6.0.7
Schedule of Critical PM2.5 Activities

Activity	Due Date	Comments
Network development	January 15, 1998	Preliminary list of sites and samplers required
Sampler order	March 2, 1998	Samplers ordered from National contract
Laboratory design	February 1, 1998	Listing of laboratory requirements
Laboratory procurement	April 1, 1998	Ordering/purchase of all laboratory and miscellaneous field equipment
Personnel Requirements	April 1, 1998	Advertising for field and laboratory personnel (if required)
QAPP development	May-Sept., 1998	Development of the QAPP
Network design completion	July 1, 1998	Final network design
Samplers begin to arrive	July 1, 1998	Delivery of FRM samplers begins
Sampler siting/testing	July-December, 1998	Establishment of sites and preliminary testing of samplers
Field/Laboratory Training	August, 1998	Field and laboratory training activities and certification.
Draft QAPP Submittal	September 1, 1998	Draft QAPP submittal to U.S. EPA Region IX
QAPP Submittal	November 12, 1998	QAPP submittal to U.S. EPA
QAPP Approval	November 30, 1998	Approval by U.S. EPA
Pilot testing	August-December 1998	Pilot activities to ensure efficiency of measurement system
Installation of 1998 sites	December 31, 1998	Sites must be established and ready to collect data
Routine Sampling	January 1, 1999	Routine activities must start

Y.6.6 PROJECT RECORDS

The ARB will establish and maintain procedures for the timely preparation, review, approval, issuance, use, control, revision and maintenance of documents and records. Table Y.6.0.8 represents the categories and types of records and documents which are applicable to document control for PM2.5 information. Information on key documents in each category are explained in more detail in Element 9.

Table Y.6.0.8
Critical Documents and Records

Categories	Record/Document Types
Management and Organization	State Implementation Plan Reporting agency information Organizational structure Personnel qualifications and training Training Certification Quality management plan Document control plan U.S. EPA Directives Grant allocations Support Contract
Site Information	Network description Site characterization file Site maps Site Pictures
Environmental Data Operations	QA Project Plans Standard operating procedures (SOPs) Field and laboratory notebooks Sample handling/custody records Inspection/maintenance records
Raw Data	Any original data (routine and QC data) including data entry forms
Data Reporting	Air quality index report Annual SLAMS air quality information Data/summary reports Journal articles/papers/presentations
Data Management	Data algorithms Data management plans/flowcharts PM2.5 Data Data Management Systems
Quality Assurance	Network reviews Control charts Data quality assessments QA reports System audits Response/Corrective action reports Site Audits

References

1. U.S. EPA (1997a) National Ambient Air Quality Standards for Particulate Matter - Final Rule, 40 CFR Part 50. *Federal Register*, **62**(138):38651-38760, July 18, 1997.

2. U.S. EPA Quality Assurance Guidance Document 2.12: Monitoring PM2.5 in Ambient Air Using Designated Reference or Class I Equivalent Methods, March 1998.

Y.7.0 ELEMENT 7 - QUALITY OBJECTIVES AND CRITERIA FOR MEASUREMENT DATA

Y.7.1 DATA QUALITY OBJECTIVES (DQOS)

Data quality objectives (DQOs) are qualitative and quantitative statements derived from the DQO Process that clarify the monitoring objectives, define the appropriate type of data, and specify the tolerable levels of decision errors for the monitoring program[1]. By applying the DQO Process to the development of a quality system for PM2.5, the U.S. EPA guards against committing resources to data collection efforts that do not support a defensible decision. During the months from April to July of 1997, the DQO Process was implemented for the PM2.5. The DQOs were based on the data requirements of the decision maker(s). Regarding the quality of the PM2.5 measurement system, the objective is to control precision and bias in order to reduce the probability of decision errors. Assumptions necessary for the development of the DQO included:

1. *The DQO is based on the annual arithmetic mean National Ambient Air Quality Standards (NAAQS*).

   The PM2.5 standards are a 15 µg/m^3 annual average and a 65 µg/m^3 24-hour average. The annual standard is met when the 3-year average of annual arithmetic means is less than or equal to 15 µg/m^3. Due to rounding, the 3-year average does not meet the NAAQS if it equals or exceeds 15.05 prior to rounding. The 24-hour average standard is met when the 3-year average 98th percentile of daily PM2.5 concentrations is less than or equal to 65 µg/m^3.

   AIRS PM2.5 data were reviewed for two purposes: (a) to determine the relative importance"of the two standards; and (b) to suggest "reasonable" hypothetical cases for which decision makers would wish to declare attainment and nonattainment with high probability. Twenty-four locations were found to have at least one year of PM2.5 data in AIRS. Figure Y.7.0.1 displays the annual averages and 98th percentiles that are associated with lognormal distributions for the 47 data sets. Figure Y.7.0.1 does not display estimates derived according to the standard, as the data sets covered one rather than three years, but it does indicate the relative importance of the two standards. Points to the right of the vertical line may be viewed as exceeding the annual average standard. Points above the horizontal line

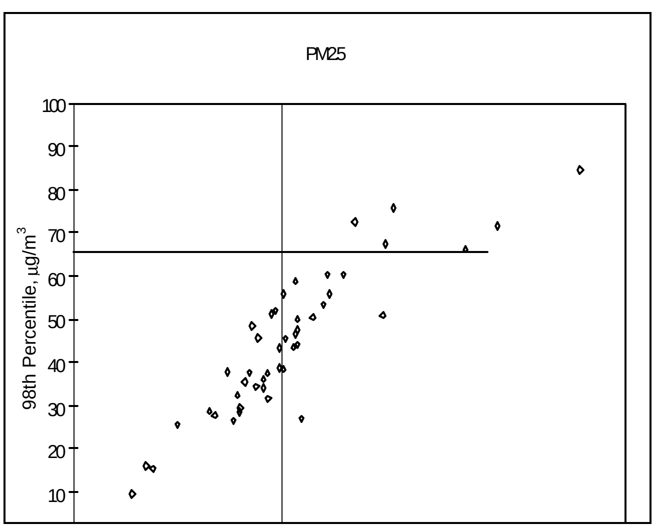

Figure 7.0.1 Annual arithmetic mean and 24-hour 98th percentiles associated with selected data sets

exceeding the 24-hour average standard. All of those points are also to the right of the vertical line, indicating that the annual standard is the "controlling" standard for these locations. For this reason, the DQOs discussed in the remainder of this document focus on attainment with the annual average standard.

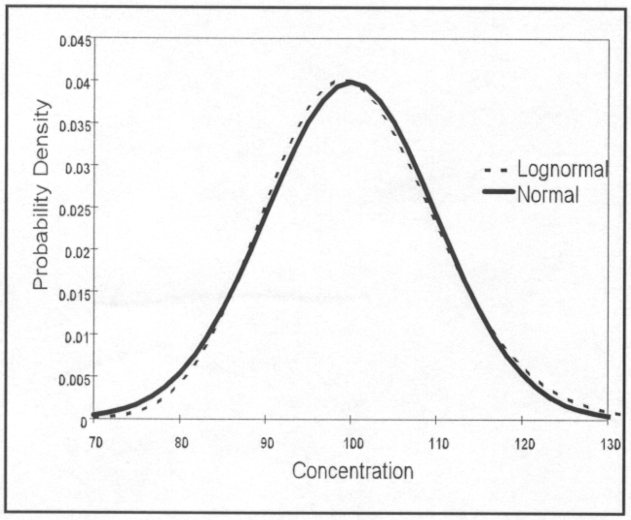

Figure Y.7.0.1
Comparison of normal and lognormal density functions at low measurement error (10% CV)

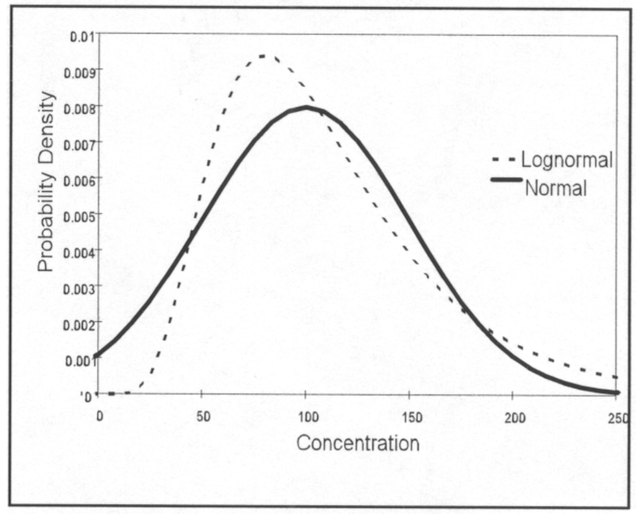

Figure Y.7.0.2
Comparison of normal and lognormal density Functions at higher measurement errors (50% CV)

2. *Normal distribution for measurement error.*

   Error in environmental measurements is often assumed to be normal or lognormal. Figures Y.7.0.2 and 7.0.3 attempt to illustrate what happens to the normal and lognormal distribution functions for the same median concentration at two values for measurement error (CV's of 10 and 50%). In the case of PM2.5, the measurement error is expected to be in the range of 5 to 10% of the mean, as shown in Figure Y.7.0.2, where normal or lognormal errors produce close to identical results. Therefore, due to these comparable results and its simplicity in modeling, the normal distribution of error was selected.

3. *Decision errors can occur when the estimated three-year average differs from the actual, or true, three-year average.*

   Errors in the estimate are due to population uncertainty (sampling less frequently than every day) and measurement uncertainty (bias and imprecision). The false positive decision error occurs whenever the estimated three-year average exceeds the standard and the actual three-year average is less than the standard. The false negative decision error occurs whenever the estimated three-year average is less than the standard and the actual three-year average is greater than the standard.

4. *The limits on precision and bias are based on the smallest number of sample values in a three-year period.*

   Since the requirements allow 1-in-6-day sampling and a 75% data completeness requirement, the minimum number of values in a 3-year period is 137. It can be demonstrated that obtaining more data, either through more frequent sampling or the use of spatial averaging, will lower the risk of attainment/non-attainment decision errors at the same precision and bias acceptance levels.

5. *The decision error limits were set at 5%.*

   For the two cases that follow, the decision maker will make the correct decision 95% of the time if precision and bias are maintained at the acceptable levels. For cases that are less “challenging”(i.e., annual average values that are farther from the standard), the decision maker will make the correct decision more often. This limit was based on the minimum number of samples from assumption 4 above (137) and the present uncertainty in the measurement technology. However, if precision and bias prove to be lower than the DQO, the decision maker can expect to make the correct decision more than 95% of the time.

6. *Measurement imprecision was established at 10% coefficient of variation (CV).* By reviewing available AIRS data and other PM2.5 comparison studies, it was determined that it was reasonable to allow measurement imprecision at 10% CV. While measurement imprecision has relatively little impact on the ability to avoid false positive and false negative decision errors, it is an important factor in estimating bias. CV’s greater than 10% make it difficult to detect and correct bias problems. Two sine functions were developed (case 1 and 2) to represent distributions where decision makers began to be concerned about decision errors. Table Y.7.0.1 summarizes the case 1 and 2 distributions.

Table Y.7.0.1.
Summary of Case 1 and 2 Parameters

	Model Equation	**Mean**	**Correct Decision**	**Incorrect Decision**	**Tolerable Error Rate**
Case 1	C_D=12.75+8.90 sin(2pD/365)+d_D	12.75	Attainment	F(+) = nonattainment	5%
Case 2	C_D=18.4+12.85 sin(2pD/365)+d_D	18.4	Nonattainment	F(-) = attainment	5%

Table Y.7.0.2.
Measurement System Decision

Precision CV (%)	Bias (%)	Decision Error Probability False Positive (%)
0	+5	0.18
0	+10	4.4
0	+15	26.8 (not acceptable)
80	0	1.3
100	0	3.0
10	+10	4.7
15	+10	5.1

Case 1: With this model (case 1), the 3-year average is 12.75 $\mu g/m^3$. The correct decision is "attainment." A false positive error is made when the estimated average exceeds the standard. The probability of the false positive error for sampling every 6th day depends on the measurement system bias and precision, as shown in Table Y.7.0.2
As stated in assumption 6 above, the data in Table Y.7.0.2 show that precision alone has little impact on decision error, but is an important factor for bias, which is an important factor in decision error.

Since the decision error probability limits were set at 5% (assumption 5), acceptable precision (CV) and bias are combinations yielding decision errors around 5%.

Table Y.7.0.3.
Measurement System Decision

Precision CV(%)	Bias(%)	Decision Error Probability False Negative (%)
0	-5	<0.1
0	-10	1.6
0	-15	18.9 (not acceptable)
80	0	1.2
100	0	2.8
10	-10	1.8
15	-10	2.1

Case 2: With this model (case 2) , the 3-year average is 18.4 $\mu g/m^3$. The correct decision is "nonattainment." A false negative error is made when the estimated average is less than the standard. The probability of the false negative error for sampling every sixth day depends on the measurement system bias and precision, as shown in the Table Y.7.0.3. Similar to case 1, combinations of precision and bias that yield decision error probabilities around 5% were considered acceptable.

After reviewing cases 1 and 2, based upon the acceptable decision error of 5%, the DQO for acceptable precision (10% CV) and bias ($\pm$ 10%) were identified. These precision and bias values will be used as a goal from which to evaluate and control measurement uncertainty.

Y.7.2 MEASUREMENT QUALITY OBJECTIVES (MQO)

Once a DQO is established, the quality of the data must be evaluated and controlled to ensure that it is maintained within the established acceptance criteria. In order to meet DQOs, guidelines must be put in place to insure the accuracy and proper interpretation of the data collected. Measurement quality objectives (MQOs) are designed to evaluate and control various phases (sampling, preparation, analysis) of the measurement process to ensure that total measurement uncertainty is within the range prescribed by the DQOs. Information regarding these objectives and their use can be found in the U.S. EPA's Quality Assurance Handbook, Volume II[2]. MQOs can be defined in terms of the following data quality indicators:

<u>Accuracy</u> - Accuracy has been a term frequently used to represent closeness to “truth” and includes a combination of precision and bias error components. This term has been used throughout 40 CFR and in some of the Elements of this document. Based on ARB performance audits, PM2.5 flow data shall be within ±4% of the true value.

<u>Precision</u> - a measure of mutual agreement among individual measurements of the same property usually under prescribed similar conditions. This is the random component of error. Precision is estimated by various statistical techniques using some derivation of the standard deviation. For ambient particulate concentration measurements, precision shall be expressed in terms of a coefficient of variation.

<u>Bias</u> - the systematic or persistent distortion of a measurement process which causes error in one direction. Bias will be determined by estimating the positive and negative deviation from the true value as a percentage of the true value.

<u>Representativeness</u> - a measure of the degree which data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, a process condition, or an environmental condition. Spatial and temporal data representativeness shall be achieved by assuring that criteria are met for station siting as defined in federal regulations, and that air quality measurements and statistics are compiled.

<u>Detection Limit</u> - a measure of the capability of an analytical method to distinguish low concentrations of a specific analyte.

<u>Completeness</u> - a measure of the amount of valid data obtained from a measurement system compared to the amount that was expected to be obtained under correct, normal conditions. Data completeness requirements are included in the reference methods (40 CFR 50). In addition, the ARB shall strive to obtain at least 85% data completeness, while maintaining the precision and accuracy objectives. Data completeness (DC) for a single pollutant at a single site (SS) is defined as:

$$\%DC = \frac{\begin{pmatrix}\text{total number of}\\ \text{samples possible}\end{pmatrix} - \begin{pmatrix}\text{Samples lost to}\\ \text{calibration}\end{pmatrix} - \begin{pmatrix}\text{samples lost to}\\ \text{downtime}\end{pmatrix}}{\text{total number of samples possible}} \times 100$$

Data completeness for the reporting organization (RO) for a single pollutant shall be defined as:

$$\%DC_{RO} = \frac{1}{n} \sum_{I=1}^{n} \%DC_{SS_I}$$

Where n = the number of stations reporting

Comparability - a measure of confidence with which one data set can be compared to another. Data comparability shall be achieved through the use of uniform procedures and U.S. EPA designated reference or equivalent methods statewide.

For each of these attributes, acceptance criteria can be developed. Various parts of 40 CFR have identified acceptance criteria for some of these attributes as well as *Guidance Document 2.12*[2]. In theory, if these MQOs are met, measurement uncertainty should be controlled to the levels required by the DQO. Tables Y.7.0.4, 7.0.5a, and 7.0.5b list the MQOs for PM2.5 program. More detailed descriptions of these MQO's and how they will be used to control and assess measurement uncertainty will be described in Elements 14 and 23, as well as SOPs (Appendix B and Appendix E) of this QAPP.

NOTE: Tables Y.7.0.4, 7.0.5a, and 7.0.5b are currently under review by the PM2.5 Data Validation Template Work Group and are subject to change.

Table Y.7.0.4
Measurement Quality Objectives - Critical Criteria

CRITICAL CRITERIA TABLE

1/ value must be flagged, S- Single Filter, G- Group of filters (i.e. batch), G1-Group of filters from 1 instrument

Criteria	Acceptable Range	Frequency	Number of Samples Impacted	40 CFR Reference	QA Guidance Document 2.12 Reference
Filter Holding Times					
Sample Recovery	≤ 4 days from sample end date	all filters	S	Part 50, App. L Sec 10.10	Sec. 8.2
Post-sampling Weighing	≤ 10 days at 25° C from sample end date, or ≤ 30 days at 4° C from sample end date	all filters	S	Part 50, App. L Sec 8.3	Sec. 7.11
Sampling Period (including multiple power failures)	1380-1500 minutes, or value if < 1380 and exceedance of NAAQS 1/	all filters	S	Part 50, App.L Sec 3.3 Part 50, App.L Sec 7.4.15	Sec. 8.2
Sampling Instrument					
Average Flow Rate	average within 5% of 16.67 liters/minute	every 24 hours of op	S	Part 50, App.L Sec 7.4	Sec. 8.2
Individual Flow Rates	no flow rate excursions > ±5% for > 5 min. 1/	every 24 hours of op	S	Part 50, App.L Sec 7.4.3.1	"
Variability in Flow Rate	CV ≤ 2%	every 24 hours of op	S	Part 50, App.L Sec 7.4.3.2	
Filter					
Visual Defect Check	see reference	all filters	S	Part 50, App.L Sec 10.2	Sec 7.5
Filter Conditioning Environment					
Equilibration	24 hours minimum	all filters	G	Part 50, App.L Sec 8.2	Sec. 7.6
Temp. Range	24-hr mean 20-23° C	all filters	G	Part 50, App.L Sec 8.2	Sec. 7.6
Temp.Control	± 2° C SD* over 24 hr	all filters	G	Part 50, App.L Sec 8.2	Sec. 7.6
Humidity Range	24-hr mean 30% - 40% RH or ≤±5% sampling RH but > 20%RH	all filters	G	Part 50, App.L Sec 8.2	Sec. 7.6
Humidity Control	± 5% SD* over 24 hr.	all filters	G	Part 50, App.L Sec 8.2	Sec. 7.6
Pre/post Sampling RH	difference in 24-hr means ≤ ± 5% RH	all filters	S/G	Part 50, App.L Sec 8.3.3	"
Balance	located in filter conditioning environment	all filters	G	Part 50, App.L Sec 8.3.2	Sec. 7.2
Calibration/Verification					
One-point FR Check	± 4% of transfer standard	1/4 weeks	G1	Part 50, App.L, Sec 9.2.5	Sec 8.4

***= Variability estimate not defined in CFR**

Table Y.7.0.5a
Measurement Quality Objectives - Operational Evaluations

OPERATIONAL EVALUATIONS TABLE
1/ value must be flagged, S- Single Filter, G- Group of filters (i.e. batch), G1-Group of filters from 1 instrument

Criteria	Acceptance Range	Frequency	Number of Samples Impacted	40 CFR Reference	QA Guidance Document 2.12 Reference
Filter Checks					
Lot Blanks	less than 15 µg change between weighings	3 filters per lot	G	not described	Sec. 7.7
Exposure Lot Blanks	less than 15 µg change between weighings	3 filters per lot	G	not described	Sec. 7.7
Filter Integrity (exposed)	no visual defects	each filter	S	not described	Sec. 8.2
Filter Holding Times					
Pre-sampling	< 30 days before sampling	all filters	S	Part 50, App.L Sec 8.3	Sec. 7.9
Detection Limit					
Lower DL	≤ 2 µg/m^3	all filters	G/G1	Part 50, App.L Sec 3.1	
Upper Conc. Limit	≥ 200 µg/m^3	all filters	G/G1	Part 50, App.L Sec 3.2	
Lab QC Checks					
Field Filter Blank	± 30 µg change between weighings	10% or 1 per weighing session	G/G1	Part 50, App.L Sec 8.3	Sec. 7.7
Lab Filter Blank	± 15 µg change between weighings	10% or 1 per weighing session	G	Part 50, App.L Sec 8.3	Sec. 7.7
Balance Check	≤3 µg	beginning, every 10th sample, end	G	not described	Sec. 7.9
Duplicate Filter Weighing	± 15 µg change between weighings	1 per weighing session	G	not described	Sec 7.11
Sampling Instrument					
Filter Temp Sensor	no excursions of > 5° C lasting longer than 30 min $^{1/}$	every 24 hours of op	S	Part 50, App.L Sec 7.4	
Calibration/Verification					
External Leak Check	< 80 mL/min	every 5 sampling events*	G1	Part 50, App.L, Sec 7.4	Sec. 6.6 & 8.4
Internal Leak Check	< 80 mL/min	every 5 sampling events	G1	Part 50, App.L, Sec 7.4	Sec. 6.6 & 8.4
Temperature Calibration	± 2°C of standard	if multi-point failure	G1	Part 50, App.L, Sec 9.3	Sec. 6.4
Temp M-point Verification	± 2°C of standard	on installation, then 2/yr	G1	Part 50, App.L, Sec 9.3	Sec. 6.7 & 8.2
One-point Temp Check	± 4°C of standard	1/4 weeks	G1	Part 50, App.L, Sec 9.3	Sec. 6.7 & 8.2
Pressure Calibration	± 10 mm Hg	on installation, then 2/yr	G1	Part 50, App.L, Sec 9.3	Sec. 6.5
Pressure Verification	± 10 mm Hg	1/4 weeks	G1	Part 50, App.L, Sec 9.3	Sec. 6.7 & 8.2
Monitor Calibrations	per manufacturers' SOP	per manufacturers' SOP	G	not described	
Microbalance Calibration	Manufacturer's specifications	1/yr	G	Part 50, App. L, Sec. 8.1	Sec. 7.2
Lab Temperature	± 2°C	1/3 months	G	not described	
Lab Humidity	± 2%	1/3 months	G	not described	

Table Y.7.0.5a
Measurement Quality Objectives - Operational Evaluations (cont.)

OPERATIONAL EVALUATIONS TABLE

1/ value must be flagged, S- Single Filter, G- Group of filters (i.e. batch), G1-Group of filters from 1 instrument

Criteria	Acceptance Range	Frequency	Number of Samples Impacted	40 CFR Reference	QA Guidance Document 2.12 Reference
Precision					
Collocated Samples	CV ≤ 10%	every 6 days for 25% of sites	G	Part 58, App.A, Sec 3.5 and 5.5	Sec. 10.2
Accuracy					
Temperature Audit	± 2°C	1/yr	G1	not described	Sec. 10.2
Pressure Audit	±10 mm Hg	1/yr	G1	not described	Sec. 10.2
Balance Audit	± 0.050 mg or manufacturers specs, whichever is tighter	1/yr	G	not described	Sec. 10.2
Flow Rate Audit	± 4% of audit standard ± 5% of design flow rate	1/2wk (automated) 1/yr (manual)	G1	Part 58, App A, Sec 3.5	Sec. 10.1 & 10.2
Calibration & Check Standards (working standards)					
Field Thermometer	± 0.1° C resolution, ± 0.5° C accuracy	1/yr	G/G1	not described	Sec 4.2 & 6.4
Field Barometer	± 1 mm Hg resolution, ± 5 mm Hg accuracy	1/yr	G/G1	not described	Sec 4.2 & 6.5
Working Mass Stds. (compare to primary standards)	0.025 mg	1/3 mo.	G	not described	Sec 4.3 and 7.3
Calibration/Verification					
Flow Rate (FR) Calibration	± 2% of transfer standard	if multi-point failure	G1	Part 50, App.L, Sec 9.2	Sec 6.3
FR Multi-point Verification	± 2% of transfer standard	2/yr	G1	Part 50, App.L, Sec 9.2	Sec 6.3 & 6.7
Design Flow Rate Adjustment	± 2% of design flow rate	at one-point or multi-point	G1	Part 50, App.L, Sec 9.2.6	
Monitor Maintenance					
Impactor	cleaned/changed	every 5 sampling events	G1	not described	Sec 9.2
Inlet/downtube Cleaning	cleaned	every 15 sampling event	G1	not described	Sec 9.3
Filter Chamber Cleaning	cleaned	monthly	G1	not described	Sec 9.3
Leak Check *	see ***Calibration/Verification***				
Circulating Fan Filter Cleaning	cleaned/changed	monthly	G1	not described	Sec 9.3
Manufacturer-Recommended Maintenance	per manufacturers' SOP	per manufacturers' SOP	G1	not described	not described

* Scheduled to occur immediately after impactor cleaned/changed.

Table Y.7.0.5b
Measurement Quality Objectives - Systematic Issues

SYSTEMATIC ISSUES
1/ value must be flagged, S- Single Filter, G- Group of filters (i.e. batch), G1-Group of filters from 1 instrument

Criteria	Acceptable Range	Frequency	Number of Samples Impacted	40 CFR Reference	QA Guidance Document 2.12 Reference
Data Completeness	75%	quarterly	G1	Part 50, App. N, Sec. 2.1	
Reporting Units	$\mu g/m^3$ at ambient temp/pressure	all filters		Part 50.3	Sec. 11.1
Standards Recertifications					
Flow Rate Transfer Std.	± 2% of NIST-traceable Std.	4/yr	G/G1	Part 50, App.L Sec 9.1 & 9.2	Sec. 6.3
Field Thermometer	± 0.1° C resolution, ± 0.5° C accuracy	1/yr	G/G1	Not described	Sec 4.2.2
Field Barometer	± 1 mm Hg resolution, ± 5 mm Hg accuracy	1/yr	G/G1	"	Sec 4.2.2
Primary Mass Stds. (compare to NIST-traceable standards)	0.025 mg	1/yr	G	"	Sec 4.3.7
Microbalance					
readability	1 µg	at purchase	G	Part 50, App.L Sec 8.1	Sec 4.3.6
repeatability	1µg	1/yr	G	Not described	Sec 4.3.6
Calibration & Check Standards				Part 50, App. L, Sec. 9.1	Sec. 6.3.2
Flow Rate Transfer Std.	± 2% of NIST-traceable Std.	1/yr	G1	Part 50, App. L, Sec. 9.2	Sec. 6.3.3
Calibration/Verification					
Clock/timer Verification	1 min/mo	1/4 weeks	G1	Part 50, App.L, Sec 7.4	not described
Precision					
Single analyzer	CV≤ 10%	1/3 mo.	G1	Part 50, App. A, Sec. 5.5	not described
Single Analyzer	CV ≤ 10%	1/ yr	G1	"	not described
Reporting Org.	CV ≤ 10%	1/3 mo.	G	"	not described
Bias					
FRM Performance Evaluation	± 10%	25% of sites 4/yr	G/G1	Part 58, App A, Sec 3.5	Sec 10.2

Y.8.0 ELEMENT 8 - SPECIAL TRAINING REQUIREMENTS

Personnel assigned to the PM2.5 ambient air monitoring activities will meet the educational, work experience, responsibility, personal attributes, and training requirements for their positions. Records on personnel qualifications and training will be maintained in personnel files and will be accessible for review during audit activities. Adequate education and training are integral to any monitoring program that strives for reliable and comparable data. Training is aimed at increasing the effectiveness of employees and the California ARB.

Y.8.1 AMBIENT AIR MONITORING TRAINING

Appropriate training is available to employees supporting the Ambient Air Quality Monitoring Program, commensurate with their duties. Such training may consist of classroom lectures, workshops, forums, teleconferences, and on-the-job training.

The ARB plans to train supervisors, management, field and laboratory staff by several means. Supervisors and management at the ARB will hold and attend several U.S. EPA, ARB, and district meetings to keep informed about this new monitoring program as it develops.

On March 16 and 17, 1998, the ARB held a PM2.5 technical forum. Participants for the forum included the ARB, U.S. EPA, Office of Environmental Health Hazard Assessment, Bay Area Air Quality Management District (AQMD), South Coast AQMD, San Joaquin Valley Unified Air Pollution Control District, several stakeholders, and expert panelists from industry and several colleges and universities. The forum included presentations on air quality history, network planning, agency needs, stakeholders comments, and discussions on health studies, public notification and forecasting, special studies versus standing air monitoring networks, data analysis, and modeling and emission inventory assessment. A summary of the forum can be found on the ARB's web page at www.arb.ca.gov/pm25/tecforum/tecforum.htm.

ARB monitoring and laboratory staff training for the PM2.5 program will be conducted by two means. First, training was being coordinated with WESTAR, and during August 1998, training for all field and laboratory personnel was conducted. The two-day workshop provided hands-on experience for State and local field and laboratory staff. The first day focused on field operations and included: an update from U.S. EPA, presentations by experienced PM2.5 FRM operators, hands-on training, and an open question-and-answer session with a panel of field experts. The second day focused on laboratory operations and included: presentations by laboratory experts; balance room set-up overview; break-out groups for hands-on experience with the PM2.5 FRM monitors, weighing room operations, PM2.5 data reporting to airs, and an open question-and-answer session with a panel of laboratory experts.

Second, ARB management plans to make one-on-one training available for ARB and district staff as required. This training will most likely occur when the ARB and district staff travel to the ARB electronics shop to take possession of the samplers. Training will include sampler set-up, operation, calibration, maintenance, and repair as appropriate.

ARB staff are required to read and understand U.S. EPA QA Guidance Document 2.12, "Monitoring PM2.5 in ambient air using Designated Reference or Class I equivalent methods," 1998, and read and understand the ARB PM2.5 QAPP. ARB staff will also participate in the U.S. EPA's Air Pollution Training Institute (APTI) courses covering PM2.5 air monitoring. ARB staff will attend the APTI telecourses and view the training video tapes developed as a supplement to the courses. Below is a list of APTI courses ARB staff have attended thus far:

- Network Design and Site Selection for Monitoring PM2.5 and PM10 in Ambient Air
- PM2.5 Monitoring Methods
- PM2.5 Monitoring QA/QC

In addition, ARB staff will participate in U.S. EPA and AWMA sponsored training courses. To date, ARB staff have attended the following U.S. EPA/AWMA training:

- Air-303 National PM2.5 Speciation Laboratory Program
- Air-304 the PM2.5 Quality Assurance Program
- PM2.5 Laboratory and Sampling Equipment

ARB staff will attend PM2.5 ambient air monitoring training courses, workshops, forums, etc., on a continuous basis. In addition, ARB staff will provide additional training on laboratory and sampler operations as needed.

Y.8.2 CERTIFICATION

The ARB does not plan on establishing a certification program for site operators and laboratory personnel. Certification of site operators and laboratory personnel will be provided through U.S. EPA-provided and sponsored certification programs.

Y.9.0 ELEMENT 9 - DOCUMENTATION AND RECORDS

The following information describes the California ARB's document and records procedures for the PM2.5 Program. In U.S. EPA's QAPP regulation and guidance, U.S. EPA uses the term reporting package. Reporting package is defined as all the information required to support the concentration data reported to U.S. EPA, which includes all data required to be collected, as well as data deemed important by the ARB under its policies and records management procedures. Table Y.9.0.1 identifies these documents and records.

Y.9.1 INFORMATION INCLUDED IN THE REPORTING PACKAGE

Y.9.1.1 ROUTINE DATA ACTIVITIES

The ARB has a structured records management retrieval system that allows for the efficient archive and retrieval of records. The PM2.5 information will be included in this system. Table Y.9.0.1 includes the documents and records that will be filed according to the statute of limitations discussed in Element 9.3.

Table Y.9.0.1
PM2.5 Reporting Package Information

Categories	**Record/Document Types**
Management and Organization	State Implementation Plan Reporting agency information Organizational structure Personnel qualifications and training Quality management plan Document control plan U.S. EPA Directives Grant allocations Support Contract
Site Information	Network description Site characterization file Site maps Site Pictures

Table Y.9.0.1
PM2.5 Reporting Package Information (cont.)

Categories	**Record/Document Types**
Environmental Data Operations	QA Project Plans Standard operating procedures (SOPs) Field and laboratory notebooks Sample handling/custody records Inspection/Maintenance records Control Charts
Raw Data	All original data (routine and QC data) including data entry forms
Data Reporting	Air quality index report Annual SLAMS air quality information Data/summary reports Quarterly QC reports
Data Management	Data algorithms Data management plans/flowcharts PM2.5 Data Data Management Systems Quarterly QC reports
Quality Assurance	Network reviews Control charts Data quality assessments QA reports System audits Response/Corrective action reports Performance Audits

Y.9.1.2 ANNUAL SUMMARY REPORTS SUBMITTED TO U.S. EPA

As indicated in 40 CFR Part 58, the ARB shall submit to the U.S. EPA Administrator, through the Region IX Office, an annual summary report of all the ambient air quality monitoring data from all monitoring stations designated as SLAMS. The report will be submitted by July 1 of each year for the data collected from January 1 to December 31 of the previous year. The report will contain the following information:

PM-fine (PM2.5)

Site and Monitoring Information.

< City name (when applicable)
< county name and street address of site location
< AIRS-AQS site code
< AIRS-AQS monitoring method code

Summary Data

< Annual arithmetic mean (Fg/m^3) as specified in 40 CFR part 50, Appendix N (Annual arithmetic mean NAAQS is 15Fg/m^3)

< All daily PM-fine values above the level of the 24-hour PM-fine NAAQS (65 Fg/m^3) and the dates of occurrence
< Sampling schedule used as once every 6 days, every day, etc.
< Number of 24-hour average concentrations in the ranges listed in Table Y.9.0.2:

Table Y.9.0.2
PM2.5 Summary Report Ranges

Range	Number of Values
0 to 15 (Fg/m^3)	
16 to 30	
31 to 50	
51 to 70	
71 to 90	
91 to 110	
greater than 110	

ARB's PTSD management will certify that the annual summary is accurate to the best of their knowledge. This certification will be based on the various assessments and reports performed by the organization, in particular, the Annual QA Report discussed in Element 21 that documents the quality of the PM2.5 data and the effectiveness of the quality system.

Y.9.2 DATA REPORTING PACKAGE FORMAT AND DOCUMENTATION CONTROL

Table Y.9.0.1 represents the documents and records, at a minimum, that must be filed into the reporting package. The details of these various documents and records will be discussed in the appropriate elements of this document.

All raw data required for the calculation of a PM2.5 concentration, the submission to the AIRS database, and QA/QC data, are collected electronically or on data forms that are included in the field and analytical methods Elements. All hardcopy information will be filled out in indelible ink. Corrections will be made by inserting one line through the incorrect entry, initialing this correction, and placing the correct entry alongside the incorrect entry, if this can be accomplished legibly, or by providing the information on a new line.

Y.9.2.1 NOTEBOOKS

The ARB will issue notebooks to each field and laboratory technician. The notebooks will be associated with the individual and the PM2.5 Program. Although data entry forms are associated with all routine environmental data operations, the notebooks can be used to record additional information about these operations.

Field notebooks - Notebooks will be issued for each sampling site. The notebooks will contain the appropriate data forms for routine operations, as well as inspection and maintenance forms and SOPs.

Lab Notebooks - Notebooks will also be issued for the laboratory. These notebooks will be associated with the PM2.5 Program One notebook will be available for general comments/notes; others will be associated with the temperature and humidity recording instruments, the freezer, calibration equipment/standards, and the analytical balances used for this program.

Sample shipping/ receipt- The laboratory will package samples for shipping and will receive samples directly. Lab notebooks will be utilized for sample shipping and receiving information and data will be entered into the Laboratory Information Management System.

Y.9.2.2 ELECTRONIC DATA COLLECTION

It is anticipated that certain instruments will provide an automated means for collecting information that would otherwise be recorded on data entry forms. Information on these systems are detailed in Elements 18 and 19. In order to reduce the potential for data entry errors, automated systems will be utilized where appropriate and will record the same information that is found on data entry forms.

Y.9.3 DATA REPORTING PACKAGE ARCHIVING AND RETRIEVAL

As stated in 40 CFR part 31.42, in general, all the information listed in Table Y.10.0.1 will be retained for three years from the date the grantee submits its final expenditure report, unless otherwise noted in the funding agreement. However, if any litigation, claim, negotiation, audit or other action involving the records has been started before the expiration of the three-year period, the records will be retained until completion of the action and resolution of all issues which arise from it, or until the end of the regular three-year period, whichever is later. The ARB will extend this regulation in order to store records for three full years past the year of collection. For example, any data collected in calendar year 1999 (1/1/99 - 12/31/99) will be retained until, at a minimum, January 1, 2003, unless the information is used for litigation purposes.

Y.10.0 ELEMENT 10 - SAMPLING DESIGN

Complete details for this Element of the QAPP can be found in the "1998 California Particulate Matter Monitoring Network Description" which was submitted by ARB's PTSD to U.S. EPA Region IX in June 1998. It is located on the ARB's web page at http://arbis.ca.gov/aqd/pm25/pmfdsign.htm. Below is background information on the 1998 California Particulate Matter Monitoring Network Description. Elements 10.1, 10.2, 10.3, and 10.4 provide additional information requested by U.S. EPA Region IX.

The goal of the PM2.5 monitoring program is to provide ambient data that support the nation's air quality programs. These data include aerosol mass measurements and chemically resolved, or speciated data. Mass measurements are used principally for PM2.5 national ambient air quality standards (NAAQS) comparison purposes in identifying areas that meet or do not meet the PM2.5 NAAQS and in supporting area designations as attainment or nonattainment. Chemically resolved data serve the implementation needs associated with developing emission mitigation approaches to reduce ambient aerosol levels. These needs include emissions inventory and air quality model evaluation, source attribution analysis, and tracking the success of emission control programs.

The California ARB, in partnership with the local air quality management districts within California, has developed a PM2.5 monitoring network to implement the new PM2.5 NAAQS. The term PM2.5 applies to airborne particles with aerodynamic diameter less than 2.5 microns. The PM2.5 network is designed to enable the air quality management community in California to collect ambient PM2.5 data as required by Title 40 of the Code of Federal Regulations (40 CFR), Parts 50, 53, and 58, published in the Federal Register on July 18, 1997. The ambient data from this network will be used for designating areas as attainment or nonattainment for the PM2.5 air quality health standards, developing control programs, and tracking the progress of these control programs.

During the early stages of the PM2.5 network design process, the ARB and the local air quality management districts established monitoring planning areas (MPA) for the State. There are 18 MPAs that have been used for locating PM2.5 monitoring sites throughout California. They are determined to be the best geographical divisions for the PM2.5 monitoring network planning. They are not intended for designating areas as attainment or nonattainment or for determining specific PM2.5 control measures. The boundaries to be used for these purposes will not be established until adequate PM2.5 data are available. The ARB and the local air quality management districts will recommend appropriate nonattainment boundaries to the U.S. EPA.

The "1998 California Particulate Matter Monitoring Network Description" consists of a statewide summary and 17 appendices. Each appendix includes a detailed description of the proposed network for each designated MPA in the State, except that the network description for the Coachella Valley MPA is included with the network description for the South Coast MPA. The objective of this document is to summarize the particulate matter monitoring strategy for California.

Upon reviewing the ARB's PM2.5 Network Design, Region IX requested that the ARB describe how collocated sites were selected. Element 10.1, below, describes the rationale for the design of collocated samplers.

Y.10.1 RATIONALE FOR THE DESIGN OF COLLOCATED SAMPLERS

In order to estimate the precision and bias of the various PM2.5 samplers, the U.S. EPA requires that for each method designation, at least 25% of the PM2.5 sites must be collocated. In 1998, the ARB and the local air quality agencies in California plan to deploy 16 monitoring sites operating PM2.5 single channel samplers and 62 monitoring sites operating PM2.5 sequential samplers (Table Y.10.0.1). To satisfy the minimum requirement for collocated samplers in California, four sites will operate collocated single channel samplers and 16 sites will operate collocated sequential samplers.

Table Y.10.0.1
Summary of PM2.5 Samplers to be Deployed in California in 1998

Sampling Method Designation	**Number of Samplers**		
	Primary	**Collocated**	**Total**
Single Channel	16	4	20
Sequential	62	16	78
Total	78	20	98

The ARB and the local air quality management districts in California selected collocated PM2.5 sites based on the following criteria listed in order of importance:

- Measured or estimated PM2.5 concentrations - monitoring sites with high measured PM2.5 concentrations or high estimated PM2.5 concentrations based on PM10 data were selected to operate collocated samplers.

- Operating agency - agencies operating more than four PM2.5 monitoring sites will have about 25% of their PM2.5 sites collocated. Agencies operating less than four monitoring sites were geographically grouped together and a high site was selected to represent a group.

- Geographical representation - we tried to ensure geographical representation throughout California because varying meteorological and air quality conditions may influence the precision and bias of various PM2.5 samplers.

- Practical considerations - the monitoring sites selected to operate collocated PM2.5 samplers had to have enough platform room to maintain 1-4 meter spacing between primary and collocated sampler and adequate power available.

Each collocated sampler must be operated concurrently with its associated primary sampler. The one-in-six day sampling schedule was selected for collocated samplers so that the sampling days are distributed evenly over the year and over the seven days of the week.

The adequacy of the quality assurance PM2.5 network will be reviewed during the 1999 annual network review and, if needed, additional collocated sites will be selected.

Y.10.2 DESIGN ASSUMPTIONS

The sampling design is based on the assumption that following the rules and guidance provided in CFR and guidance for network design and optimum site exposure for PM2.5 and PM10 will result in data that can be used to measure compliance with the national standards. The ARB and the local air quality management districts established 18 MPAs as the administrative framework for planning a PM2.5 monitoring network. With few exceptions, the boundaries of MPAs correspond to the boundaries of the various air basins in the State. California is divided geographically into air basins for the purpose of managing the air quality resources on a regional basis. Areas within each air basin are considered to share the same air masses and are therefore expected to have similar ambient air quality. The State is currently divided into 15 air basins.

The State is also divided into air pollution control districts and air quality management districts, which are county or regional governing authorities that have primary responsibility for controlling air pollution from stationary sources. In the South Central Coast Air Basin and the Salton Sea Air Basin, the MPAs correspond to the local district boundaries of the agencies having jurisdictions over these areas. The splitting of these air basins facilitates the development of the PM2.5 network plans within these MPAs. The South Central Coast Air Basin has been divided into three MPAs, one for each of the districts in the air basin. The Salton Sea Air Basin has been divided into two MPAs, Coachella Valley MPA, which is under the jurisdiction of the South Coast AQMD, and the Imperial County MPA, which is under the jurisdiction of the Imperial County APCD.

Y.10.3 SITING PM2.5 SAMPLERS

The following is a list of the network design objectives that were given the highest priority during the PM2.5 network design:

- Satisfy the U.S. EPA core monitoring requirements
- Represent California air basins and provide geographical representation
- Represent high concentrations in populated areas
- Characterize emission sources in high concentration areas
- Consider the needs of ongoing special health studies for particle measurements

The ARB and the local air quality districts analyzed all available information to develop a list of sites that would best satisfy these objectives. Preference was given to adapting existing sites to PM2.5 monitoring. During the site selection process, the ARB and the local air quality districts considered the following factors:

- Population statistics
- Land use characteristics
- Climate
- Suspected area emission sources (e.g., wood smoke, agricultural burning, etc.)
- Existing monitoring network
- Existing particulate matter data, including dichot and PM10 data
- Potential transport corridors
- Ongoing special health studies

The PM2.5 monitoring network planned for California will consist of the following sites:

- Eighty-nine core PM2.5 State and local air monitoring stations (SLAMS). All core sites will collect data to determine attainment status with regard to both of the new PM2.5 standards. In addition, many of these sites will satisfy other monitoring objectives, including transport assessment and assistance in health studies
- Two background sites to measure the lowest ambient PM2.5 concentrations representative of California
- One special purpose transport assessment site primarily operated to determine the impact of transported PM2.5 on ambient concentrations in the receptor area
- Thirteen Interagency Monitoring of Protected Visual Environments (IMPROVE) sites to assess visibility impairment in Class I areas. Not all of the existing IMPROVE sites will be integrated with the PM2.5 program and some new sites will be established over the next two years in an effort to integrate visibility assessment with the PM2.5 monitoring. The IMPROVE protocol at these sites will be changed to make it more compatible with the national PM2.5 program

Y.10.4 CORE PM2.5 STATE AND LOCAL AIR MONITORING STATIONS

The proposed PM2.5 monitoring network includes 89 PM2.5 monitoring sites to collect data for comparison to the NAAQS. These sites are situated to meet the requirements for core PM2.5 monitoring sites (core sites). Based on U.S. EPA regulations, core sites should include:

- A population-oriented site with the highest expected PM2.5 concentrations
- A site in an area of high population density with poor air quality (not necessarily located in an area of expected maximum concentrations)
- A site collocated at a PAMS site, for each PAMS area included in the MPA

The core sites are the most important sites in the PM2.5 network. Each core site will operate from samplers purchased through the national PM2.5 procurement contract established by the U.S. EPA. Only data from core sites are eligible for comparison to both the annual and 24-hour PM2.5 naaqs. All of the sites proposed for 1998 have a population-oriented location and neighborhood zone of representation. The neighborhood zone of representation means that the 24-hour concentrations should vary by no more than ±10 percent over an area whose diameter is between 0.5 and 4 kilometers.

All core sites selected to operate PM2.5 from samplers are located in populated areas with expected high PM2.5 concentrations for the broader area they represent. Some core sites will provide useful information about PM2.5 transport and emission sources. Each of the California air basins will have at least one PM2.5 monitoring site. Air basins with high population and expected high PM2.5 concentrations will have additional monitoring sites to provide better geographical representation.

Y.11.0 ELEMENT 11 - SAMPLING METHODS REQUIREMENTS

Y.11.1 PURPOSE/BACKGROUND

This method provides for measurement of the mass concentration of fine particulate matter having an aerodynamic diameter less than or equal to a nominal 2.5 micrometers (PM2.5) in ambient air over a 24-hour period for purposes of determining whether the primary and secondary national ambient air quality standards (NAAQS) for particulate matter specified in 40 CFR Part 50.7 are met. The measurement process is considered to be non-destructive, and the PM2.5 sample obtained can be subjected to subsequent physical or chemical analyses.

Y.11.2 SAMPLE COLLECTION AND PREPARATION

FROM samplers will be used as the monitor for collection of PM2.5 samples for comparison to the NAAQS. In the ARB network, there are two models of the FROM sampler employed. The Rupprecht & Patashnick (R&P) Sampler is a single-day sampler that meets FROM designation. The Andersen Sampler is a multiple-day sampler that meets FROM designation. Each sampler shall be installed with adherence to procedures, guidance, and requirements detailed in 40 CFR Parts 50[1] , 53, and 58[2] ; U.S. EPA QA Guidance Document 2:12[3]; the sampler manufacturers operation manual; ARB's Field SOPs; and this QAPP.

Y.11.2.1 <u>SAMPLE SET-UP</u>

Sample set-up of the FROM or speciation sampler in the ARB network takes place any day after the previous sample has been recovered. For multiple day samplers, two sample days may be set up when 1-in-3-day sampling is required. It is important to recognize that the only holding time that affects sample set-up is the 30-day window (ARB has asked U.S. EPA to extend this to a 90-day window--see Table 11.0.6) from the time a filter is preweighed to the sampling period. At collocated sites, the second monitor will be set up to run at a sample frequency of 1-in-6-days; however, sample set-up will take place on the same day as the primary sampler. Detailed sample set-up procedures are available from the ARB PM2.5 sample methods standard operating procedure, Appendix E.

Y.11.2.2 <u>SAMPLE RECOVERY</u>

Sample recovery of any individual filter from the FROM or speciation sampler in the ARB network must occur within 96 hours of the end of the sample period for that filter. For one-in-three day sampling on single day samplers, this will normally be the day after a sample is taken. The next sample would also be set-up at this time. For one-in-three day sampling on multiple day samplers, this will normally be on the day after the second sample is taken. The next sample set-up for two samples would also take place on this day. At collocated sites the sample from the second monitor will be recovered on the same day as the primary sampler. Sample recovery procedures are detailed in the ARB PM2.5 sampling methods standard operating procedure, Appendix E.

Table Y.11.0.1 illustrates sample set-up, sample run, and sample recovery dates based upon sample frequency requirements of one-in-three day sampling.

Table Y.11.0.1
Sample Set-up, Run and Recovery Dates

Sample Frequency	**Sampler Type**	**Sunday**	**Monday**	**Tuesday**	**Wednesday**	**Thursday**	**Friday**	**Saturday**
1 in 3 Week 1	Multiple Day	Sample Day 1			Sample Day 2	*Recovery & Set-up*		Sample Day 3
1 in 3 Week 2	Multiple Day			Sample Day 4	*Recovery & Set-up*		Sample Day 5	
1 in 3 Week 3	Multiple Day		Sample Day 6	*Recovery & Set-up*		Sample Day 7		
1 in 3 Week 4	Multiple Day	Sample Day 8	*Recovery & Set-up*		Sample Day 9	*Recovery & Set-up*		Sample Day 10
1 in 3 Week 5	Multiple Day			Sample Day 11	*Recovery & Set-up*		Sample Day 12	
1 in 3 Week 6	Multiple Day		Sample Day 13	*Recovery & Set-up*		Sample Day 14		
1 in 3 Week 1	Single Day	Sample Day 1	*Recovery & Set-up*		Sample Day 2	*Recovery & Set-up*		Sample Day 3
1 in 3 Week 2	Single Day		*Recovery & Set-up*	Sample Day 4	*Recovery & Set-up*		Sample Day 5	*Recovery & Set-up*
1 in 3 Week 3	Single Day		Sample Day 6	*Recovery & Set-up*		Sample Day 7	*Recovery & Set-up*	

Therefore, sites that utilize multiple day samplers with the one-in-three day sampling frequency will require one site visit a week, except for one out of every four weeks, where two sites visits will be required. For sites that utilize single day samplers with one-in-three-day sampling frequency, a recovery and set-up visit will be required for every sample taken.

Y.11.3 SUPPORT FACILITIES FOR SAMPLING METHODS

Table Y.11.0.2 lists the supplies that are available to PM2.5 field operators. Support facilities for PM2.5 sampling include offices, trailers, and vehicles.

Table Y.11.0.2
Support Facility Supplies

Item	Minimum Quantity	Notes
Powder Free Gloves	box	*Material must be inert and static resistant*
Fuses	2	*Of the type specified in the sampler manual*
Sampler Operations Manual	1 per model	
PM2.5 Sampling SOP	1	
Flow rate verification filter	2	
Non-Permeable Membrane	2	*Contained in sampling cassette*
Filter Cassettes	2	*For use with flow rate check filter or non-permeable membrane*
Impactor Oil	1 Bottle	
Cleaning Wipes	1 Box	*Dust resistant*
Data Download Cable	1	*Downloading mechanism (to be determined)*

Since there are other items that the field operator may need during a site visit that are not expected to be at each site, the operator is expected to bring these items with him/her. Table Y.11.0.3 details those items each operator is expected to bring with them.

Table Y.11.0.3
Site Dependent Equipment and Consumables

Item	Minimum Quantity	Notes
Tools	1 box	*screw drivers, fitted wrenches, etc...*
WINS Impactor Assembly	1	*Without impactor oil*
FROM Filter Cassettes	1 for each sampler, plus field blanks	*Loaded with pre-weighed filter*
Transport Container	2	*1 for pre-weighed, 1 for sampled filter.*

Y.11.4 SAMPLING/MEASUREMENT SYSTEM CORRECTIVE ACTION

Corrective action measures in the PM2.5 Air Quality Monitoring Network will be taken to ensure the data quality objectives are attained. There is the potential for many types of sampling and measurement system corrective actions. Table Y.11.0.4 is an attempt to detail the expected problems and corrective actions needed for a well-run PM2.5 network.

Table Y.11.0.4
Field Corrective Action

Item	Problem	Action	Notification
Filter Inspection (Presample)	Pinhole(s) or torn	1) If additional filters have been brought, use one of them. Void filter with pinhole or tear. 2) Use new field blank filter as sample filter. 3) Obtain a new filter from lab.	1) Document on field data sheet. 2) Document on field data sheet. 3) Notify Field Manager
Filter Inspection (Postsample)	Torn or otherwise suspect particulate by-passing 46.2 mm filter.	1) Inspect area downstream of where filter rests in sampler and determine if particulate has been by-passing filter. 2) Inspect in-line filter before sample pump and determine if excessive loading has occurred. Replace as necessary.	1) Document on field data sheet. 2) Document in log book.
WINS Impactor	Heavily loaded with coarse particulate as indicated by a "cone" shape on the impactor well.	Clean downtube and WINS impactor. Load new impactor oil in WINS impactor well .	Document in log book.
Sample Flow Rate Verification	Out of Specification ($\pm$ 4% of transfer standard and $\pm$5% of design flow rate.)	1) Remove flow rate device, re-connect and repeat flow rate check. 2) Perform leak test. 3) Check flow rate at 3 points (15.0 LPM, 16.7 LPM, and 18.3 LPM) to determine if flow rate problem is with zero bias or slope. 4) Re-calibrate flow rate.	1) Document on data sheet. 2) Document on data sheet. 3) Document on data sheet. Notify Field Manager. 4) Document on data sheet, notify Field Manager, and flag data since last calibration.
Leak Test	Leak outside acceptable tolerance (<80 mL/min)	1) Remove leak check adaptor, re-connect and repeat leak test. 2) Inspect all seals and O-rings, replace as necessary and repeat leak test.	1) Document in log book. 2) Document in log book, notify Field Manager, and flag data since last successful leak test.
Sample Flow Rate	Consistently low flows documented during sample run	1) Check programming of sampler flow rate. 2) Check flow with a flow rate verification filter and determine if actual flow is low. 3) Inspect in-line filter downstream of 46.2 mm filter location, replace as necessary.	1) Document in log book. 2) Document in log book. 3) Document in log book.

Table Y.11.0.4
Field Corrective Action (cont.)

Item	Problem	Action	Notification
Ambient Temperature Verification, and Filter Temperature Verification.	Out of Specification (± 4EC of standard)	1) Make certain thermocouples are immersed in same liquid at same point without touching sides or bottom of container. 2) Use ice bath or warm water bath to check a different temperature. If acceptable, repeat ambient temperature verification. 3) Connect new thermocouple. 4) Check ambient temperature with another NIST traceable thermometer.	1) Document on data sheet. 2) Document on data sheet. 3) Document on data sheet. Notify Field Manager. 4) Document on data sheet. Notify Field Manager.
Ambient Pressure Verification	Out of Specification (±10 mm Hg)	1) Make certain pressure sensors are each exposed to the ambient air and are not in direct sunlight. 2) Call local Airport or other source of ambient pressure data and compare that pressure to pressure data from monitors sensor. Pressure correction may be required. 3) Connect new pressure sensor.	1) Document on data sheet. 2) Document on data sheet. 3) Document on data sheet. Notify Field Manager.
Elapsed Sample Time	Out of Specification (1 min/mo)	Check Programming, Verify Power Outages	Notify Field Manager
Elapsed Sample Time	Sample did not run	1) Check Programming 2) Try programming sample run to start while operator is at site. Use a flow verification filter.	1) Document on data sheet. Notify Field Manager 2) Document in log book. Notify Field Manager.
Power	Power Interruptions	Check Line Voltage	Notify Field Manager
Power	LCD panel on, but sample not working.	Check circuit breaker, some samplers have battery back-up for data but will not work without AC power.	Document in log book
Data Downloading	Data will not transfer.	Document key information on sample data sheet. Make certain problem is resolved before data is written over in sampler microprocessor.	Notify Field Manager.

Y.11.5 SAMPLING EQUIPMENT, PRESERVATION, AND HOLDING TIME REQUIREMENTS

This element details the requirements needed to prevent sample contamination, the volume of air to be sampled, temperature preservation requirements, and the permissible holding times to ensure against degradation of sample integrity.

Y.11.5.1 SAMPLE CONTAMINATION PREVENTION

The PM2.5 network has rigid requirements for preventing sample contamination. Powder free gloves are worn while handling filter cassettes. Once the filter cassette is taken outside of the weigh room, it must never be opened, as damage may result to the 46.2 mm Teflon filter. Filter cassettes are to be stored in filter cassette storage containers as provided by the sampler manufacturer during transport to and from the laboratory. Once samples have been weighed, they are to be stored with the particulate side up and individually stored in static resistant zip lock bags.

Y.11.5.2 SAMPLE VOLUME

The volume of air to be sampled is specified in 40 CFR Part 50. Sample flow rate of air is 16.67 liters per minute (LPM). The total sample of air collected will be 24 cubic meters based upon a 24-hour sample. Samples are expected to be 24 hours; however, in some cases, a shorter sample period may be necessary, not to be less than 23 hours. Since capture of the fine particulate is predicated upon a design flow rate of 16.67 LPM, deviations of greater than 10% from the design flow rate will enable a shut-off mechanism for the sampler. If a sample period is less than 23 hours or greater than 25 hours, the sample will be flagged.

Y.11.5.3 TEMPERATURE PRESERVATION REQUIREMENTS

The temperature requirements of the PM2.5 network are explicitly detailed in 40 CFR Part 50, Appendix L[1]. During transport from the weigh room to the sample location, there are no specific requirements for temperature control; however, the filters will be located in their protective container and in the transport container. Excessive heat must be avoided (e.g., do not leave in direct sunlight or a closed-up car during summer). The filter temperature requirements are detailed in Table Y.11.0.5.

Table Y.11.0.5
Filter Temperature Requirements

Item	Temperature Requirement	Reference
Filter temperature control during sampling and until recovery.	No more than 5^{O} C above ambient temperature.	40 CFR Part 50, Appendix L, Element 7.4.10
Filter temperature control from time of recovery to start of conditioning.	Protected from exposure to temperatures over 25^{O} C.	40 CFR Part 50, Appendix L, Element 10.13
Postsample transport.	$\leq 25^{O}$C if weighed within 10 days or $\leq 4^{O}$C if weighed within 30 days	40 CFR Part 50, Appendix L, Element 8.3.6

Y.11.5.4 PERMISSIBLE HOLDING TIMES

The permissible holding times for the PM2.5 sample are clearly detailed in both 40 CFR Part 50, Appendix L, and the U.S. EPA QA Guidance Document 2.12. These holding times are provided in Table Y.11.0.6.

Table 11.0.6
Holding Times

Item	Holding Time	From:	To:	Reference
Preweighed Filter	$\leq$30 days*	Date of Pre-weigh	Date of Sample	40 CFR Part 50, Appendix L, Element 8.3.5
Recovery of Filter	$\leq$96 hours	Completion of sample period	Time of sample recovery	40 CFR Part 50, Appendix L, Element 10.10
Transport of Filter	<24 Hours (ideally)	Time of recovery	Time placed in conditioning room	40 CFR Part 50, Appendix L, Element 10.13
Postsample Filter stored at $<4^{o}$ C.	$\leq$30 days	Sample end date/time	Date of Post Weigh	40 CFR Part 50, Appendix L, Element 8.3.6
Postsample Filter stored at $<25^{o}$ C.	$\leq$10 days	Sample end date/time	Date of Post Weigh	40 CFR Part 50, Appendix L, Element 8.3.6

*NOTE: The ARB has asked U.S. EPA for a waiver to the $\leq$30-day holding time for preweighed filters. The ARB has asked U.S. EPA to extend this time to $\leq$90 days.

References

The following documents were utilized in the development of this Element:

1. U.S. EPA (1997a) National Ambient Air Quality Standards for Particulate Matter - Final Rule, 40 CFR Part 50. *Federal Register*, **62**(138):38651-38760. July 18,1997.

2. U.S. EPA (1997b) Revised Requirements for Designation of Reference and Equivalent Methods for PM2.5 and Ambient Air Quality Surveillance for Particulate Matter-Final Rule, 40 CFR Parts 53 and 58. *Federal Register*, **62**(138):38763-38854; July 18, 1997.

3. U.S. EPA Quality Assurance Guidance Document 2.12: Monitoring PM2.5 in Ambient Air Using Designated Reference or Class I Equivalent Methods; March 1998.

Y.12.0 ELEMENT 12 - SAMPLE CUSTODY

Due to the potential use of the PM2.5 data for comparison to the NAAQS and the requirement for extreme care in handling the sample collection filters, sample custody procedures will be followed. Figures Y.12.0.1 and Y.12.0.2 represent chain of custody forms that will be used to track the stages of filter handling throughout the data collection operation. Definitions of parameters on the forms are explained in Table Y.12.0.1. Although entries on this form will be made by hand, the information will be entered into the sample tracking system, where an electronic record will be kept (see Element 19). This Element addresses sample custody procedures at the following stages:

- Pre-sampling
- Post-sampling
- Filter receipt
- Filter archive

CARB 24 Hour - FIELD SAMPLE REPORT
Federal Reference Method PM 2.5 Filter Samplers

Bar Code:
LIMS Sample ID:

Site Name: ____________________
AIRS Site Number: ____________________
Field Technician: ____________________
Agency: ____________________

Cassette I. D. Number: ____________________
Sampling Date / Port Number: ________ / ________
Sampler Make, Model & ID#: ____________________

SAMPLE SUMMARY

☐ Check if data electronically submitted to Laboratory

Elapsed Time: ____________ Hr:min
Volume: ____________ M^3
Flow CV: ____________ %
Start Date /Time: ____________ / ____________

	Ambient Temp: (°C)	Ambient Pressure: (mm Hg)
Average:		
Minimum:		
Maximum:		

Local Condition Codes: ____________

Sampler Flag Codes: ____________

A.	High Winds	E.	Forest Fire
K.	Farming Nearby	J.	Construction Nearby
N.	Sanding/Salting Streets	L.	Highway Construction
P.	Roofing Operations	Q.	Prescribe Burn

F.	Flowrate 5-min average, out of spec
T.	Filter Temp differential, 30 minutes interval out of spec
E.	Elapsed sample time, out of spec

Operator Comments: ____

Chain of Custody

ACTION	DATE	TIME	FILTER TEMP °C	NAME
Sample Load				
Sample Removal				
Sample placed in cooler				
Sample shipped to Lab				
Sample received at Lab				
Start post-conditioning				

FOR LABORATORY USE ONLY

Postweigh by:________

	Mass:	Dup Mass:	Date:	Analyst:
Preweight				
Postweight				

Lab Comments:	

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Figure Y.12.0.1
Example of Chain-of-Custody Record

Filter Archiving Tracking Form

Filter ID	Analysis Date	Archive Date	Box ID/Box #	Archived By:	Comments

Figure Y.12.0.2
Filter Archive Form

Table Y.12.0.1
Parameter List

Parameter	Frequency	Comment
Pre-Sampling		
Site Operator Initial	Every sample	Initials of the site operator setting up the sampling run.
Filter ID	Every sample	Unique filter ID of filter given by the weighing laboratory.
Container ID	Every Sample	Unique ID for the protective containers used to transport the filters. These are reusable.
Receipt Date From Lab	Every sample	Date filter taken by the site operator from storage to the field.
Sampler ID	Every sample	Sampler serial number or unique bar code number associated with the model number.
Installation Date	Every sample	Date filter was placed into sampler by the site operator.
Pre-Sampling Comments	When required	Free form comments from site operator during pre-sampling filter selection.
Post-Sampling		
Site Operator Final	Every sample	Initials of the site operator completing the sampling run.
Removal Date	Every sample	Date filter taken by the site operator from the monitor for transport from the field.
Removal Time	Every sample	Time in military units that filter was removed from monitor.
Ambient Temp.	See Comment	Data field to determine whether the sample was maintained at ambient temperature from removal through transport. If this data field is not entered, the next field ($4^{O}C$) must be.
$4^{O}C$	See Comment	Data field to determine whether the sample was maintained at the $4^{O}C$ temperature from removal through transport. If this data field is not entered, the previous field (Ambient Temp.) must be. Also if shipped next day air this field must be checked.
Filter Integrity flag	Every sample	VFI- Void Filter Integrity GFI-Good Filter Integrity
Sampler Flags	Every sample	Other field qualifier flags

Table Y.12.0.1
Parameter List (cont.)

Parameter	Frequency	Comment
Free Form Notes	As needed	Free form notes about sample recovery activity.
Shipping Information		
Delivered by Operator:	See Comment	Data field to determine whether the samples on the C-O-C sheet were delivered to the receiving facility by the site operator . If this data field is not entered, the following field (2nd party) must be.
Delivered by 2nd Party:	See Comment	Data field to determine whether the samples on the C-O-C sheet were delivered to the receiving facility by a next day carrier. If this data field is not entered, the previous field (Delivered by Operator) must be.
Filter Receipt		
Date/Time Received	Every Sample	Date/Time filter received at the Lab
Filter (Box) Min. Temp.	Filter Box	Temp. in celsius of min. temperature from max/min thermometer
Archived	See Comment	Data field to determine whether the filters were placed into cold storage at the receiving facility prior to transport to weighing lab (weekend delivery). If this data field is not entered, the next field (Sent to lab) must be.
Sent to Lab	See Comment	Data field to determine whether the sample was delivered to the weighing laboratory the day it was received. If this data field is not entered, the previous field (Archived) must be.
Free Form Notes	As needed	Free form notes about sample receipt activity, including shipping integrity

Y.12.1 SAMPLE CUSTODY PROCEDURE

One of the most important values in the sample custody procedure is the unique filter ID number, illustrated in Figure Y.12.0.3. The filter ID is an alpha-numeric value. The initial two alpha values identify the type of filter as being a PM fine (PF) filter. The next six digits represent a unique number. The filter ID will be generated by the laboratory analyst at the time of preweighing.

Filter ID

P	F	X	X	X	X	X	X
Filter Type		(-----Unique number-----)					

Figure Y.12.0.3
Filter ID

Y.12.1.1 PRE-SAMPLING CUSTODY

The ARB's laboratory SOPs (Appendix B) define how the filters will be enumerated, conditioned, weighed, placed into the protective shipping container, sealed with tape, and distributed to the site operators. Filters must be used within 30 days of pre-sampling weighing.

Y.12.1.2 POST SAMPLING CUSTODY

The field sampling SOPs (Appendix E) specify the techniques for properly collecting and handling the sample filters. Upon visiting the site:

1. Select the appropriate *Filter Chain of Custody Record*.
2. Remove filter cassette from the sampler. Briefly examine it to determine appropriate filter integrity flag and place it into the protective container per SOPs and seal with tape.
3. Place the protective container(s) into the shipping/transport container with the appropriate temperature control devices.
4. Record "Post Sampling Filter Recovery Information" on the *Filter Chain of Custody Record*.

Shipping Information:

Depending on the number of sites to be serviced, the location of the sites, and the time period from the end of sample collection, the site operator will either deliver the sample to the laboratory or ship it to the laboratory. If the mode of transportation is via ground transport, the site operator will record the appropriate information. Pre-addressed mailing slips will be made available for site operators. Shipping requirements include:

1. Bring the shipping/transport containers to the shipping vendor.
2. Fill out the remainder of the pre-addressed shipping labels.

3. Photocopy the *Filter Chain of Custody Record*s that pertain to the shipment.
4. Place the photocopied records in a plastic zip lock bag and include it in one of the shipping/transport containers.
5. Seal all shipping/transport containers per SOPs.
6. The site operator will take the original *Filter Chain of Custody Record*s(s) and attach the shipping labels to the records.
7. The site operator will contact the receiving laboratory of a shipment the day of the shipment.

Y.12.1.3 FILTER RECEIPT

If samples are transported to the laboratory by the site operator, they will be delivered directly to the PM2.5 weighing laboratory with the associated filter chain of custody record(s). For samples that are transported by ground transport, they will be delivered to the Shipping/Receiving Office. The Shipping/Receiving Office will:

1. Receive shipping/transport container(s).
2. Upon receipt, remove the samples from the shipping container and place the samples in the Shipping/Receiving office freezer.
3. Immediately notify the ILS staff that a shipment has been received.

Y.12.1.4 FILTER ARCHIVE

Once the PM2.5 weighing laboratory receives the filter, they will use their raw data entry sheets to log the samples back in from receiving and prepare them for post-sampling weighing activities. These activities are included in the analytical SOPs (Element 13). The laboratory technicians will take the filters out of the protective containers and the cassettes and examine them for integrity, which will be marked on the data entry sheets. The samples will be stored within the PM2.5 weighing laboratory.

Upon completion of post-sampling weighing activities, the *Filter Archiving Form* (Figure Y.12.3) will be used by the laboratory technicians to archive the filter. Each filter will be packaged according to the SOPs and stored in a box uniquely identified by Site ID and box number. Samples will be archived in the laboratory freezer for one year past the date of collection. Prior to disposal, U.S. EPA Region IX will be notified of the ARB's intent to dispose of the filters.

Y.13.0 ELEMENT 13 - ANALYTICAL METHODS REQUIREMENTS

Y.13.1 PURPOSE/BACKGROUND

This method provides for gravimetric analyses of filters used in the California ARB PM2.5 network. The net weight of a sample is calculated by subtracting the initial weight from the final weight. Once calculated, the net weight can be used with the total volume sampled through a filter to calculate the ambient concentration for comparison to the daily and annual NAAQS. Since the method is non-destructive, and due to possible interest in sample composition, the filters will be archived after final gravimetric analyses has occurred.

Y.13.2 PREPARATION OF SAMPLES

Upon delivery of approved 46.2 mm Teflon filters for use in the ARB network, the receipt is documented and the filters stored in the conditioning/weighing room/laboratory. Storing filters in the laboratory makes it easier to maximize the amount of time available for conditioning. Upon receipt, cases of filters will be labeled with the date of receipt, opened one at a time and used completely before opening another case. All filters in a lot will be used before a case containing another lot is opened. When more than one case is available to open, the “First In - First Out” rule will apply. This means that the first case of filters received is the first case that will be used.

Filters will be taken out of the case when there is enough room for more samples in the presampling weighing section of the filter conditioning storage compartment. Filters will be visually inspected according to the FROM criteria to determine compliance. See Appendix B for inspection procedure for new shipments of filters. Filters will then be stored in the filter conditioning compartment for a minimum period of 24 hours. Filters will not be left out for excessive periods of conditioning, since some settling of dust is possible on the filters’ top sides.

Y.13.3 ANALYSIS METHOD

Y.13.3.1 <u>ANALYTICAL EQUIPMENT AND METHOD</u>

The analytical instrument used for gravimetric analysis in the FROM or equivalent PM2.5 sampler method (gravimetric analysis) is the microbalance. The ARB will use a *Sartorius M3P* and/or a *Sartorius M5P* microbalance, each of which has a readability* of 1 Fg and a repeatability* of 1Fg (* equipment performance terms used by balance vendors to characterize their equipment for purchase comparison purposes; see also Appendix B).

Both microbalances are calibrated yearly by a balance technician from *Quality Control Services* under the service agreement between the ARB and *Quality Control Services*. The gravimetric analysis method (Appendix B) consists of information needed to establish and verify the continued acceptability of the set of primary and secondary mass reference standards and a new lot of filters, and to establish stable conditions in the weighing room. The three main subparts cover presampling filter weighing (tare weight); postsampling documentation and inspection; and postsampling filter weighing (gross weight). The details of the gravimetric analysis method can be found in the ARB microbalance standard operating procedure (Appendix B).

Y.13.3.2 CONDITIONING AND WEIGHING ROOM

The primary support facility for the PM2.5 network is the filter conditioning and weighing room/laboratory. Additional facility space is dedicated for long term archiving of the filter. This weighing room/laboratory is used for both presampling and postsampling weighing of each PM2.5 filter sample. Specific requirements for environmental control of the conditioning/weighing room laboratory are detailed in 40 CFR Part 50 Appendix L[1]

Y.13.3.3 ENVIRONMENTAL CONTROL

The ARB weighing room facility is an environmentally controlled room with temperature and humidity control. Temperature is controlled at a minimum from 20 to 23^{O} C. Humidity is controlled between 30 and 40% relative humidity. Temperature and relative humidity are measured and recorded continuously during equilibration. The balance is located on a vibration free table and is protected from or located out of the path of any sources of drafts. Filters are conditioned before both the pre- and post-sampling weighings. Filters must be conditioned for at least 24 hours to allow their weights to stabilize before being weighed.

Y.13.4 INTERNAL QC AND CORRECTIVE ACTION FOR MEASUREMENT SYSTEM

A QC notebook or database (with disk backups) containing QC data will be maintained, including microbalance calibration and maintenance information, routine internal QC checks of mass reference standards and laboratory and field filter blanks, and external QA audits. These data will duplicate data recorded on laboratory data forms but will consolidate them so that long-term trends can be identified. It is recommended that QC charts be maintained on each microbalance and included in this notebook. These charts may allow the discovery of excess drift that could signal an instrument malfunction.

At the beginning of each weighing session, after the analyst has completed zeroing and calibrating the microbalance and measuring the working standard, three laboratory filter blanks established for the current filter lot are weighed. Filter blanks from the most recently completed field blank study are also weighed. After approximately every 10th filter weighing, the analyst will reweigh one working standard. The microbalance is rezeroed as necessary between each weighing. The working standard and blank measurements are recorded in the laboratory QC notebook or database. If the working standard measurements differ from the certified values or the pre-sampling values by more than 3 µg, the working standard measurements will be repeated. If the blank measurements differ from the presampling values by more than 15 µg, the blank measurements will be repeated. If the two measurements still disagree, the Laboratory Manager will be contacted, who may direct the analyst to (1) reweigh some or all of the previously weighed filters, (2) recertify the working standard against the laboratory primary standard, (3) conduct minor, non-invasive diagnostic and troubleshooting, and/or (4) arrange to have the original vendor or an independent, authorized service technician troubleshoot or repair the microbalance. Corrective action measures in the PM2.5 FROM system will be taken to ensure good quality data. There is the potential for many types of sampling and measurement system corrective actions. Tables Y.13.0.1 (organized by laboratory support equipment) and Y.13.0.2 (organized by laboratory support activity) list potential problems and corrective actions needed to support a well run PM2.5 network. Filter weighing will be delayed until corrective actions are satisfactorily implemented.

Table Y.13.0.1
Potential Problems/Corrective Action for Laboratory Support Equipment

System	Item	Problem	Action	Notification
Weigh Room	Humidity	Out of Specification	Check HVAC system	Lab Manager
Weigh Room	Temperature	Out of Specification	Check HVAC system	Lab Manager
Balance	Internal Calibration	Unstable	Redo and check working standards	Lab Manager
Balance	Zero	Unstable	Redo and check for drafts, sealed draft guard	Lab Manager
Balance	Working Standards	Out of Specification	Check balance with Primary standards	Lab Manager
Balance	Filter Weighing	Unstable	Check Lab Blank Filters	Document in Log Book

Table Y.13.0.2
Filter Preparation and Analysis Checks

Activity	Method and frequency	Requirements	Action if the requirements are not met
Microbalance Use		Resolution of 1 µg, repeatability of 1 µg	Obtain proper microbalance
Control of bal. environment		Climate-controlled, draft-free room or chamber or equivalent	Modify the environment

Table Y.13.0.2
Filter Preparation and Analysis Checks (cont.)

Activity	Method and frequency	Requirements	Action if the requirements are not met
Use of Mass reference standards	Working standards checked every 3 to 6 months against laboratory primary standards	Standards up to 200 mg*, individual standard's tolerance less than 25 µg, handle with smooth, nonmetallic forceps	Obtain proper standards or forceps
Filter handling	Observe handling procedure	Use powder-free gloves and smooth forceps. Replace ^{210}Po antistatic strips every 6 months	Discard mishandled filter or old antistatic strip
Filter integrity check	Visually inspect each filter	No pinholes, separation, chaff, loose material, discoloration, or filter nonuniformity	Discard defective filter
Filter identification	Write filter number on filter handling container, and on laboratory data form in permanent ink	Make sure the numbers are written legibly	Replace label or correct form
Presampling filter equilibration	Determine the correct equilibration conditions and period (at least 24 hours) for each new lot of filters. Observe and record the equilibration chamber relative humidity and temperature; enter to lab data form.	Check for stability of laboratory blank filter weights. Weight changes must be <15 µg before and after equilibration Mean relative humidity between 30 and 40 percent, with a variability of not more than ±5 percent standard deviation over 24 hours. Mean temperature will be held between 20 and 23 EC, with a variability of not more than than ±2 EC standard deviation over 24 hours.	Revise equilibration conditions and period. Repeat equilibration
Initial filter weighing	Observe all weighing procedures. Perform all QC checks	Neutralize electrostatic charge on filters. Wait long enough so that the balance indicates a stable reading.	Repeat weighing
Internal QC	After every tenth filter, reweigh one of the two working standards. Weigh three laboratory filter blanks. Reweigh at least one duplicate filter with each sample batch (duplicate weighing).	The working standard measurements must agree to within 3 µg of the certified values. The blank and duplicate measurements must agree to within 15 µg.	Flag values for validation activities.

Table Y.13.0.2
Filter Preparation and Analysis Checks (cont.)

Activity	Method and frequency	Requirements	Action if the requirements are not met
Postsampling inspection, documentation, and verification	Examine the filter and field data sheet for correct and complete entries. If sample was shipped in a cooled container, verify that low temperature was maintained.	No damage to filter. Field data sheet complete. Sampler worked OK.	Notify Lab Manager. Void sample.
Postsampling filter equilibration	Equilibrate filters for at least 24 hours. Must be within ± 5% RH of pre-sampling weighing conditions.	Mean relative humidity between 30 and 40 percent, with a variability of not more than ±5 percent standard deviation over 24 hours. Mean temperature will be held between 20 and 23 EC, with a variability of not more than ±2 EC standard deviation over 24 hours.	Repeat equilibration
Postsampling filter weighing	Observe all weighing procedures. Perform all QC checks.	Neutralize electrostatic charge on filters. Wait 30 seconds after balance indicates a stable reading before recording data.	Repeat weighing

*For the following 3 reasons, the multipoint calibration for this method will be zero, 100, and 200 mg: 1) the required sample collection filters weigh between 100 and 200 mg; 2) the anticipated range of sample loadings for the 24-hour sample period is rarely going to be more than a few 100Fg; and 3) the lowest, commercially available check weights that are certified according to nationally accepted standards are only in the single milligram range. Since the critical weight is not the absolute unloaded or loaded filter weight, but the difference between the two, the lack of microgram standard check weights is not considered cause for concern about data quality, as long as proper weighing procedure precautions are taken for controlling contamination, or other sources of mass variation in the procedure (see SOP in Appendix B).

Y.13.5 FILTER SAMPLE CONTAMINATION PREVENTION, PRESERVATION, AND HOLDING TIME REQUIREMENTS

This element details the requirements needed to prevent and protect the filter sample from contamination, the volume of air to be sampled, temperature preservation requirements, and the permissible holding times to ensure against degradation of sample integrity.

Y.13.5.1 SAMPLE CONTAMINATION PREVENTION

The analytical support component of the PM2.5 network has rigid requirements for preventing sample contamination. Filters are equilibrated/conditioned and stored in the same room where they are weighed. Filters are only contacted with the use of smooth, nonserrated forceps. Upon determination of its presampling weight, the filter is placed in its cassette and then placed in a protective petri dish. The petri dish is labeled with a unique identifying number. The filter is never removed from the filter cassette outside of the weigh room, as damage may result to the 46.2 mm teflon filter.

Y.13.5.2 SAMPLE VOLUME

The volume of air to be sampled is specified in 40 CFR Part 50. The sampling flow rate is 16.67 LPM. Total sample of air collected will be 24 cubic meters, based upon a 24-hour sample.

Y.13.5.3 TEMPERATURE PRESERVATION REQUIREMENTS

The temperature requirements of the PM2.5 network are explicitly detailed in 40 CFR Part 50. In the weighing room laboratory, the filters must be conditioned for a minimum of 24 hours prior to pre-weighing; although a longer period of conditioning may be required. The weighing room laboratory temperature must be maintained between 20 and 23^{O}C, with no more than a +/- 2^{O}C standard deviation change over the 24-hour period prior to weighing the filters. During transport from the weighing room to the sample location, there are no specific requirements for temperature control; however, the filters will be located in their protective container and excessive heat avoided. Temperature requirements for the sampling and postsampling periods are detailed in 40 CFR Part 50, Appendix L Section 7.4.10. These requirements state that the temperature of the filter cassette during sampler operation and in the period from the end of sampling to the time of sample recovery shall not exceed that of the ambient temperature by more than 5^{O}C for more than 30 minutes.

The specifics of temperature preservation requirements are clearly detailed in 40 CFR Part 50, Appendix L[1]. These requirements pertain to both sample media before collection and both the sample media and sample after a sample has been collected. Additionally, during the sample collection, there are requirements for temperature control. The temperature requirements are detailed in Table Y.13.0.3.

Table Y.13.0.3
Temperature Requirements

Item	Temperature Requirement	Reference
Weighing Room	20 - 23^{O}C	40 CFR Part 50, Appendix L, Section 8.2.1
Preweighed Filter	+/- 2^{O}C standard deviation for 24 hours prior to weighing	40 CFR Part 50, Appendix L, Section 8.2.2
Filter Temperature Control during sampling and until recovery	No more than 5^{O}C above ambient temperature.	40 CFR Part 50, Appendix L, Section 7.4.10
Post Sample Transport	$\leq$ 25^{O}C if weighed within 10 days or $\leq$ 4^{O}C if weighed within 30 days	40 CFR Part 50, Appendix L, Section 8.3.6

Y.13.5.4 PERMISSIBLE HOLDING TIMES

The permissible holding times for the PM2.5 sample are clearly detailed in both 40 CFR Part 50[1] and the U.S. EPA QA Guidance Document 2.12[2]. A summary of these holding times are provided in Table 11.0.6 in Element 11.5.4.

References

The following documents were utilized in the development of this element:

1. U.S. EPA (1997a) National Ambient Air Quality Standards for Particulate Matter - Final Rule 40 CFR Part 50. Federal Register, 62(138): 38651-38760. July 18, 1997.

2. U.S. EPA Quality Assurance Guidance Document 2.12: Monitoring PM2.5 in Ambient Air Using Designated Reference or Class I Equivalent Methods. March 1988.

Y.14.0 ELEMENT 14 - QUALITY CONTROL REQUIREMENTS

To assure the quality of data from air monitoring measurements, two distinct and important interrelated functions must be performed. One function is the control of the measurement process through broad quality assurance activities, such as establishing policies and procedures, developing data quality objectives, assigning roles and responsibilities, conducting oversight and reviews, and implementing corrective actions. The other function is the control of the measurement process through the implementation of specific quality control procedures, such as audits, calibrations, checks, replicates, routine self-assessments, etc. In general, the greater the control of a given monitoring system, the better will be the resulting quality of the monitoring data. Quality control (QC) is the overall system of technical activities that measures the attributes and performance of a process, item, or service against defined standards to verify that they meet the stated requirements established by the customer. In the case of the Ambient Air Quality Monitoring Network, QC activities are used to ensure that measurement uncertainty, as discussed in Element 7, is maintained within acceptance criteria for the attainment of the DQO. Figure Y.14.0.1 represents a number of QC activities that help to evaluate and control data quality for the PM2.5 program. Many of the activities in this figure are implemented by the California ARB and are discussed in the appropriate sections of this QAPP. The other activities in this figure are implemented by the U.S. EPA.

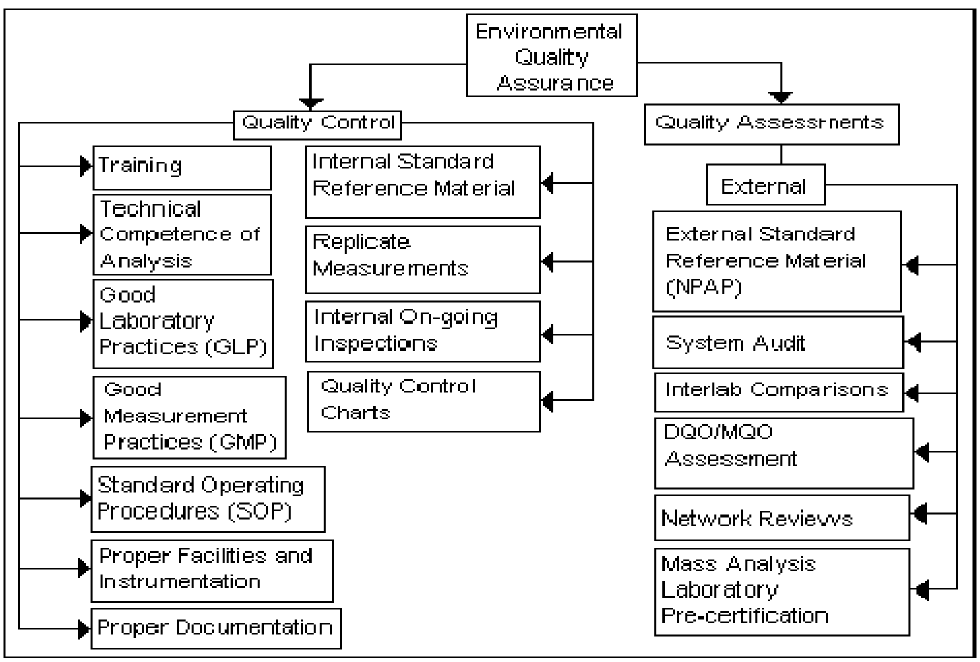

Figure 14.0.1 Quality control and quality assessment activities

Y.14.1 QC PROCEDURES

Day-to-day quality control is implemented through the use of various check samples or instruments that are used for comparison. The measurement quality objectives tables in Element 7 contain a complete listing of these QC checks, as well as other requirements for the PM2.5 Program. The procedures for implementing the QC checks are included in the field and analytical methods (Elements 11 and 13, respectively). As Figure Y.14.0.2 illustrates, various types of QC checks have been inserted at phases of the data operation to assess and control measurement uncertainties. Tables Y.14.0.1 and Y.14.0.2 contain a summary of all the field and laboratory QC checks. The following information provides some additional descriptions of these QC activities, how they will be used in the evaluation process, and what corrective actions will be taken when they do not meet acceptance criteria.

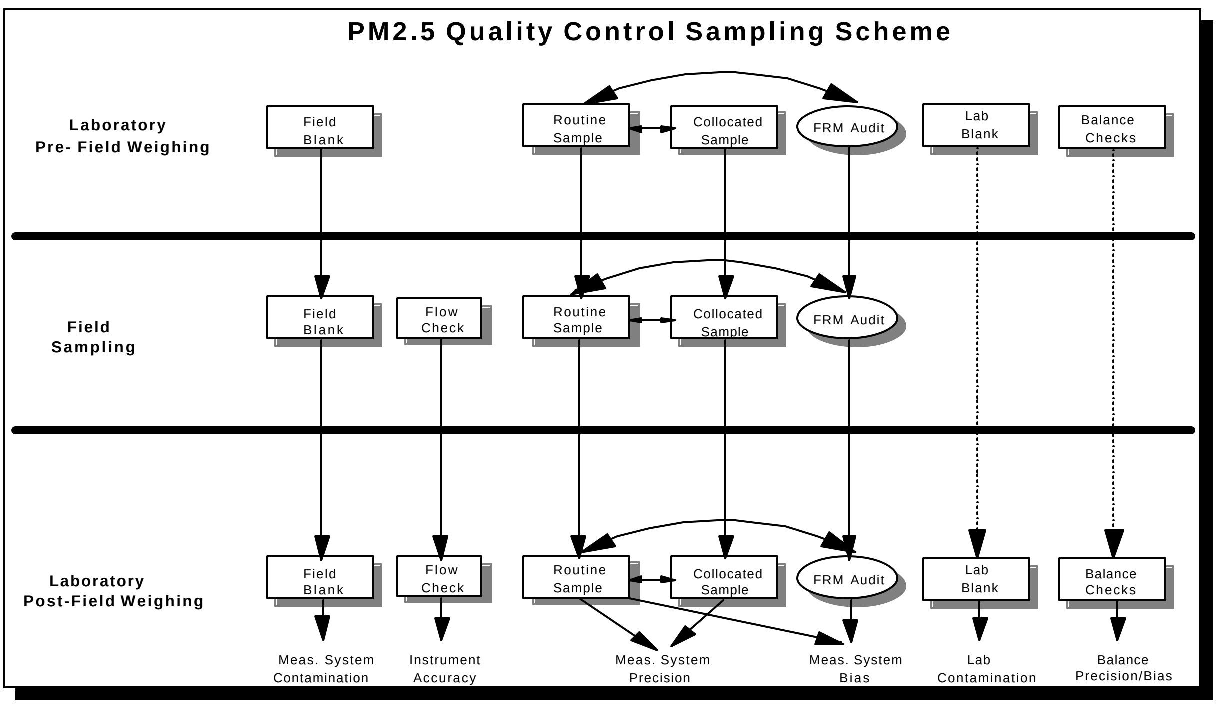

Figure 14.0.2 PM2.5 Quality control scheme

Table Y.14.0.1
Field QC Checks

Requirement	Frequency	Acceptance Criteria	CFR Reference	QA Guidance Document 2.12 Reference	Information Provided
Calibration Standards					
Flow Rate Transfer Std.	1/yr	±2% of NIST-traceable Std.	Part 50, App.L Sec 9.1, 9.2	Sec. 6.3	Certification of Traceability
Field Thermometer	1/yr	± 0.1° C resolution	not described	Sec 4.2 and 6.4	Certification of Traceability
		± 0.5°C accuracy	not described	"	
Field Barometer	1/yr	± 1 mm Hg resolution	not described	Sec. 4.2 and 6.5	Certification of Traceability
		± 5 mm Hg accuracy	not described	"	
Calibration/Verification					
Flow Rate (FR) mult-point verification	2/yr or if single-point verification failure	± 2% of transfer standard and ±2% of design FR	Part 50, App.L, Sec 9.2	Sec 6.3 and 6.7	Calibration drift and memory effects
FR single-point verification	1/4 weeks	± 4% of transfer standard and ± 4% of design FR	Part 50, App.L, Sec 9.2.5 And Sec. 9.2.6	Sec 8.4	Calibration drift and memory effects
External Leak Check	every 5 sampling events	<80 mL/min	Part 50, App.L, Sec 7.4	Sec. 6.6 and Sec. 8.4	Sampler function
Internal Leak Check	every 5 sampling events	<80 mL/min	"	Sec. 6.6 and Sec. 8.4	Sampler function
Temperature Calibration	2/yr	± 2°C of standard	Part 50, App.L, Sec 9.3	Sec. 6.4	Calibration drift and memory effects
Temp multi-point verification	on installation, then 2/yr	± 2°C of standard	Part 50, App.L, Sec 9.3	Sec. 6.7 and 8.2	Calibration drift and memory effects
One- point temp Verification	1/4 weeks	± 4°C of standard	"	"	Calibration drift and memory effects
Pressure Calibration	on installation, then 2/yr	±10 mm Hg	"	Sec. 6.5	Calibration drift and memory effects
Pressure Verification	1/4 weeks	±10 mm Hg	"	Sec. 6.7 and 8.2	Calibration drift and memory effects
Clock/timer Verification	1/ 4 weeks	1 min/mo	Part 50, App.L, Sec 7.4	not described	Verification to assure proper function
Blanks					
Field Blanks	10% of monitors sampling frequency	±30 μg	Part 50, App.L Sec 8.3	Sec. 7.7	Measurement system contamination
Precision Checks					
Collocated samples	every 6 days	CV ≤ 10%	Part 58, App.A, Sec 3.5, 5.5	Sec. 10.2	Measurement system precision
Audits *(external assessments)*					
FRM Performance Evaluation	25% of sites 4/yr	± 10%	Part 58, App A, Sec 3.5.3	Sec 10.2	Measurement system bias
Flow rate audit	1/yr*	± 4% of audit standard and ±5% of design FR	Part 58, App A, Sec 3.5	Sec 10.1 and 10.2	External verification bias/accuracy
Temperature Audit	1/yr	± 2°C	not described	"	Calibration drift and memory effects
Pressure Audit	1/yr	±10 mm Hg	not described	"	Calibration drift and memory effects

*<u>Note</u>: ***U.S. EPA REQUIREMENT STATES THAT FLOW RATE AUDITS BE CONDUCTED QUARTERLY. THE ARB HAS REQUESTED A WAIVER FROM U.S. EPA TO EXTEND THE QUARTERLY FLOW RATE AUDITS TO ANNUAL FLOW RATE AUDITS.***

Table Y.14.0.2
Laboratory QC

Requirement	Frequency	Acceptance Criteria	CFR Reference	QA Guidance Document 2.12 Reference	Information Provided
Blanks					
Lot Blanks	3 filters per lot	$\underline{+}$15 µg difference	Not Defined	2.12 Sec. 7.7	Filter stabilization/equilibrium
Lab Blanks	3 per batch	$\underline{+}$15 µg difference	Part 50, App. L, Sec 8.3	2.12 Sec. 7.7	Laboratory contamination
Calibration/Verification					
Balance Calibration	1/yr	Manufacturers spec.	Part 50, App. L, Sec 8.1	2.12 sec 7.2	Verification of equipment operation
Lab Temp. Calibration	3 mo.	$\underline{+}$ 2°C	Not Defined	QAPP Sec. 13/16	Verification of equipment operation
Lab Humidity Calibration	3 mo.	±2%	"	QAPP Sec. 13/16	Verification of equipment operation
Accuracy					
Balance Audit	1/year	$\underline{+}$0.050 mg	Not Defined	2.12 Sec 10.1 and 10.2	Laboratory technician operation
Balance Check	beginning, every 10th sample, end	≤3 µg	Not Defined	2.12 Sec. 7.9	Balance accuracy/stability
Calibration standards					
Working Mass Stds.	3 mo.	tolerance ≤ 25 µg	Not defined	2.12 Sec 4.3 and 7.3	Standards verification
Primary Mass Stds.	1/yr	tolerance ≤ 25 µg	"	"	Primary standards verification
Precision					
Duplicate filter weighings	1 per weighing session	$\underline{+}$15 µg difference	Not defined	2.12 Tab 7-1, Sec 7.11 QAPP Sec. 13/16	Weighing repeatability/filter stability

Y.14.1.1 CALIBRATIONS

Calibration is the comparison of a measurement standard or instrument with another standard or instrument to report, or eliminate by adjustment, any variation (deviation) in the accuracy of the item being compared[1]. The purpose of calibration is to minimize bias.

For PM2.5, calibration activities follow a two-step process:

1. Certifying the calibration standard and/or transfer standard against an authoritative standard, and
2. Comparing the calibration standard and or transfer standard against the routine sampling/analytical instruments.

Calibration requirements for the critical field and laboratory equipment are found in Tables Y.14.0.1 and Y.14.0.2, respectively; the details of the calibration methods are included in the calibration Element (Element 16) and in the field and laboratory methods Elements (11 and 13, respectively).

Y.14.1.2 BLANKS

Blank samples are used to determine contamination arising from principally four sources: the environment from which the sample was collected/analyzed, the reagents used in the analysis, the apparatus used, and the operator/analyst performing the data operation. Three types of blanks will be implemented in the PM2.5 Program:

Lot Blanks - a shipment of 46.2mm filters will be periodically sent from U.S. EPA to the ARB. Each shipment must be tested to determine the length of time it takes the filters to stabilize. Upon arrival of each shipment, three lot blanks will be randomly selected from the shipment and be subjected to the conditioning/pre-sampling weighing procedures. The blanks will be weighed daily for a minimum of five days to determine the length of time it takes to maintain a stable weight reading.

Field Blanks - provides an estimate of total measurement system contamination. By comparing information from laboratory blanks against the field blanks, one can assess contamination from field activities. Details of the use of the field blanks can be found in field SOPs (Appendix E).

Lab Blanks - provides an estimate of contamination occurring at the weighing facility. Details of the use of the lab blanks can be found in lab SOPs (Appendix B).

Lab Blank Evaluation -Three (3) lab blanks will be weighed in each weighing session. The following statistics will be used for data evaluation purposes:

Difference for a Single Check *(d)* - The difference, *d*, for each check is calculated using Equation 1, where *X* represents the weight of the filter measured from its previous weighing, and *Y* represents the weight of the filter measured from the current weighing session.

$$d = |Y - X| \qquad \text{Equation 1}$$

Mean Difference for Batch (d_z) - The mean difference d_z for lab blanks within a weighing session batch is calculated using Equation 2, where d_1 through d_n represent individual differences (calculated from Equation 1), and *n* represents the number of blanks in the batch.

$$d_z = \frac{d_1 + d_2 + d_3 .... d_n}{n} \qquad \text{Equation 2}$$

Corrective Action- The acceptance criteria for lab blanks is 15 μg difference as determined by Equation 1. However, the mean difference based upon the number of blanks in each batch will be used for comparison against the acceptance criteria. If the mean difference of the laboratory blanks is greater than 15 μg, then the laboratory balance will be checked for proper operation and all the lab blanks in the weighing session will be re-weighed. Prior to re-weighing, the laboratory balance will be checked for proper operation. If the blank mean is still out of the acceptance criteria, all samples within the weighing session will be flagged with the appropriate flag, and efforts will be made to determine the source of contamination. If the mean difference of the laboratory blanks is greater than 20 μg and 2 or more of the blanks were greater than 15 μg, the laboratory weighing will stop until the issue is satisfactorily resolved. The laboratory analyst will alert the Laboratory Manager of the problem. The problem and solution will be reported and appropriately filed under response and corrective action reports.

Lab blanks will be control charted (see Element 14.2). The batch difference calculation (Equation 2) is used for control charting purposes.

Field Blank Evaluation

Field blanks will be weighed in the same weighing session as associated routine samples from the site. The following statistics will be generated for data evaluation purposes:

Difference for a Single Check *(d)* - The difference, *d*, for each check is calculated using Equation 1, where *X* represents the original weight of the filter and *Y* represents the filter weight after transport to and from the monitoring site including exposure in the sampler.

d ' *Y&X*   Equation 1

Corrective Action- The acceptance criteria for field blanks is 30 Fg difference as determined by Equation 1. If the field blank value is out of the acceptance criteria, efforts will be made to determine the source of contamination. In theory, field blanks should contain more contamination than laboratory blanks. Therefore, if the field blanks are outside of the criteria while the lab blanks are acceptable, weighing can continue on the next batch of samples while field contamination sources are investigated. The laboratory analyst will alert the Laboratory Manager. The problem and solution will be reported and appropriately filed under response and corrective action reports.

Field blanks will be control charted for each monitoring site (see Element 14.2). The difference calculation (Equation 1) is used for control charting purposes.

Y.14.1.3 PRECISION CHECKS

Precision is the measure of mutual agreement among individual measurements of the same property, usually under prescribed similar conditions. In order to meet the data quality objectives for precision, the ARB must ensure the entire measurement process is within statistical control. Two types of precision measurements will be made in the PM2.5 Program.

< Collocated monitoring
< Filter duplicates

Collocated Monitoring

In order to evaluate total measurement precision, collocated monitoring will be implemented, as referenced in 40 CFR. Therefore, every method designation ***will***:

a. have 25% of the monitors collocated (values of .5 and greater round up).
b. have at least 1 collocated monitor (if total number less than 4). The first collocated monitor must be the FROM.
c. have 50% of the collocated monitors be FROM monitors and 50% must be the same method designation. If there is an odd number of collocated monitors required, bias in favor of the FROM.

The location of these monitors is described in the "1998 California Particulate Matter Monitoring Network Description", but it is anticipated that these sites will collect concentrations around the NAAQS, or will be sites where higher concentrations are expected.

Evaluation of Collocated Data- Collocated measurement pairs are selected for use in the precision calculations only when both measurements are above 6 µg/m^3. However, all collocated data will be reported to AIRS.

The following algorithms will be used to evaluate collocated data. These algorithms are included in *40 CFR Part 58 Appendix A*. The equation numbers in 40 CFR will also be utilized in this QAPP.

Percent Difference for a Single Check (d_i) - The percentage difference, d_i, for each check is calculated by using Equation 19, where X_i represents the concentration produced from the primary sampler, and Y_i represents the concentration reported for the duplicate sampler.

$$d_i = \frac{Y_i - X_i}{(Y_i + X_i)/2} \times 100 \qquad \text{Equation 19}$$

Coefficient of Variation (CV) for a Single Check (CV_i) - The coefficient of variation, CV_i, for each check is calculated by dividing the absolute value of the percentage difference, d_i, by the square root of two as shown in Equation 20.

$$CV_i = \frac{|d_i|}{\sqrt{2}} \qquad \text{Equation 20}$$

Precision of a Single Sampler - Quarterly Basis ($CV_{j,q}$) - For particulate sampler j, the individual coefficients of variation ($CV_{j,q}$) during the quarter are pooled using Equation 21, where $n_{j,q}$ is the number of pairs of measurements from collocated samplers during the quarter.

$$CV_{j,q} = \sqrt{\frac{\sum_{i=1}^{n_j} CV_i^2}{n_{j,q}}} \qquad \text{Equation 21}$$

The 90 percent confidence limits for the single sampler=s CV are calculated using Equations 22 and 23, where $\chi^2_{0.05,df}$ and $\chi^2_{0.95,df}$ are the 0.05 and 0.95 quantiles of the chi-square (χ^2) distribution with $n_{j,q}$ degrees of freedom.

$$Lower\ Confidence\ Limit = CV_{j,q}\sqrt{\frac{n_{j,q}}{\chi^2_{0.95,n_{j,q}}}} \qquad \text{Equation 22}$$

$$Upper\ Confidence\ Limit = CV_{j,q}\sqrt{\frac{n_{j,q}}{\chi^2_{0.05,n_{j,q}}}} \qquad \text{Equation 23}$$

Precision of a Single Sampler - Annual Basis - For particulate sampler *j*, the individual coefficients of variation, CV_i, produced during the calendar year are pooled using Equation 21, where n_j is the number of checks made during the calendar year. The 90 percent confidence limits for the single sampler's CV are calculated using Equations 22 and 23, where $\chi^2_{0.05,df}$ and $\chi^2_{0.95,df}$ are the 0.05 and 0.95 quantiles of the chi-square (χ^2) distribution with n_j degrees of freedom.

Corrective Action: Single Monitor - The precision data quality objective of 10% coefficient of variation (CV) is based upon the evaluation of three years of collocated precision data. The goal is to ensure that precision is maintained at this level. Therefore, precision estimates for a single pair of collocated instruments, or even for a quarter, may be greater than 10%, while the 3-year average is less than or equal to 10%. Therefore, single collocated pairs with values >10% will be flagged and reweighed. If the value remains between 10-20%, the field technician will be alerted to the problem. If the CV is greater than 20%CV for both the initial and reweigh, all the primary sampler data will be flagged from the last precision check and corrective action will be initiated. Paired CVs and percent differences will be control charted to determine trends (Element 14.2). The laboratory technician will alert the Laboratory Manager of the problem. The problem and solution will be reported and appropriately filed under response and corrective action reports.

Corrective Action: Quarter - Usually, corrective action will be initiated and imprecision rectified before a quarter's worth of data fail to meet 10% CV. However, in the case where the quarter's CV is greater than 20%, the routine data for that monitor for that quarter will be flagged. The problem and solution will be reported and appropriately filed under response and corrective action reports.

Duplicate Laboratory Measurements - During laboratory pre-weighing and post-weighing sessions, a routine filter from the sampling batch will be selected for a second weighing. Equations 1 and 2 will be used to generate this information. The difference among the weights of these two filters must be less than 15 Fg. If this criterium is not met, the pair of values will be flagged. Failure may be due to transcription errors, microbalance malfunction, or that the routine samples have not reached equilibrium. Other QC checks (balance standards and lab blanks) will eliminate microbalance malfunction. If the duplicate does not meet the criterium, a second routine sample will be selected and reweighed as a second duplicate check. If this second check fails the acceptance criteria and the possibility of balance malfunction and transcription errors have been eliminated, all samples in the batch will be equilibrated for another 24 hours and reweighed. Corrective actions will continue until duplicate weights for the batch meet acceptance criteria.

Y.14.1.4 ACCURACY OR BIAS CHECKS

Accuracy is defined as the degree of agreement between an observed value and an accepted reference value. Four accuracy checks are implemented in the PM2.5 program:

- Collocated monitors
- Flow rate audits
- Balance checks
- FROM performance evaluations

Collocated Monitors - Although the collocated monitors are primarily used for evaluating and controlling precision, they can be used to determine accuracy or bias. By using Equation 19 to determine percent difference, one can track trends or bias between the two instruments without knowing which instrument is producing the “true” value. Use of the FROM performance evaluation information (discussed below) in conjunction with collocation data should help improve the quality of data.

Corrective Action - The percent difference of the paired values will be control charted to determine trends. If it appears that there is a statistically significant bias (> 10% at the 90% confidence level) between the pairs, corrective action will be initiated. The process will include eliminating uncertainties that may be occurring at filter handling, transport, and laboratory stages, in order to determine that the bias is truly at the instrument. Corrective actions at the instrument will include multi-point temperature, pressure, and flow rate checks, as well as complete maintenance activities. Additional corrective action could include a request for vendor servicing or a request for Region IX to implement a FROM performance evaluation.

Flow Rate Audits - Since the ARB will be implementing manual in lieu of continuous sampling devices, we will implement a flow rate audit every year ***(THE ARB HAS ASKED U.S. EPA FOR A WAIVER TO THE QUARTERLY FLOW RATE AUDIT REQUIREMENT--SEE TABLE Y.14.0.1)***. Details of the implementation aspects of the audit are included in Element 11. The audit is made by measuring the analyzer's normal operating flow rate using a certified flow rate transfer standard. The flow rate standard used for auditing will not be the same flow rate standard used to calibrate the analyzer. However, both the calibration standard and the audit standard may be referenced to the same primary flow rate or volume standard. The ARB will report the audit (actual) flow rate and the corresponding flow rate indicated or assumed by the sampler. The procedures used to calculate measurement uncertainty are described below.

Accuracy of a Single Sampler - Single Check (Quarterly) Basis (d_i) - The percentage difference (d_i) for a single flow rate audit I is calculated using Equation 13, where X_i represents the audit standard flow rate (known) and Y_i represents the indicated flow rate.

$$d_i = \frac{Y_i - X_i}{X_i} \times 100 \qquad \text{Equation 13}$$

Bias of a Single Sampler - Annual Basis (D_j) - For an individual particulate sampler j, the average (D_j) of the individual percentage differences (d_i) during the calendar year is calculated using Equation 14, where n_j is the number of individual percentage differences produced for sampler j during the calendar year.

$$D_j = \frac{1}{n_j} \times \sum_{i=1}^{n_j} d_i \qquad \text{Equation 14}$$

Bias for Each U.S. EPA Federal Reference and Equivalent Method Designation Employed by the ARB - Quarterly Basis ($D_{k,q}$) - For method designation k used by the reporting organization, quarter q's single sampler percentage differences (d_i) are averaged using Equation 16, where $n_{k,q}$ is the number of individual percentage differences produced for method designation k in quarter q.

$$D_{k,q} = \frac{1}{n_{k,q}} \times \sum_{i=1}^{n_{k,q}} d_i \qquad \text{Equation 16}$$

Corrective Action - The single sampler accuracy requirement is $\pm$4% of the audit transfer standard and $\pm$5% of design flow rate. If the audit violates the acceptance criteria, the sample operator will check the sampling instrument for internal and external leaks, ensure that temperature and pressure are within acceptable ranges, and verify the flow rate. A reaudit will be scheduled. If the audit is still unacceptable, a multi-point calibration followed by a one-point verification is required. Routine data, back to an acceptable audit or the most recent multi-point calibration, will be flagged and reviewed to determine validity (see Element 23). In addition, one would expect that the flow rate calibration verification checks that will be conducted every five sampling events (see Element 16) would indicate a drift towards unacceptable accuracy. If a review of the flow rate calibration verification check data does not show a problem, there is a potential that one or both of the flow rate standards need to be recertified.

Balance Checks - Balance checks are frequent checks of the balance working standards (100 and 200 mg standards) against the balance to ensure that the balance is within acceptance criteria throughout the pre- and postsampling weighing sessions. The ARB will use ASTM class 1 weights for its primary and secondary (working) standards. Both working standards will be measured at the beginning and end of the sample batch and one standard will be selected for a measure after every 10 filters. Balance check samples will be controlled charted (see Table Y.14.0.3).

Balance Check Evaluation - The following algorithm will be used to evaluate the balance checks:

Difference for a Single Check *(d_y)* - The difference, d_y, for each check is calculated using Equation 3, where X represents the certified mass weight and Y represents the reported weight .

$$d_y = Y - X \qquad \text{Equation 3}$$

Corrective Action - The difference among the reported weight and the certified weight must be $\leq 3\mu g$. Since this is the first check before any pre- or postsampling weighings, if the acceptance criteria is not met, corrective action will be initiated. Corrective action may be as simple as allowing the balance to perform internal calibrations or to sufficiently warm-up, which may require checking the balance weights a number of times. If the acceptance criteria is still not met, the laboratory technician will be required to verify the working standards to the primary standards. Finally, if it is established that the balance does not meet acceptance criteria for both the working and primary standards, and other troubleshooting techniques fail, the *Quality Control Services* service technician (see Element 15) will be called to perform corrective action.

If the balance check fails acceptance criteria during a run, the ten filters weighed prior to the failure will be rerun. If the balance check continues to fail, troubleshooting, as discussed above, will be initiated. The values of the ten samples weighed prior to the failure will be recorded and flagged, but will remain with the unweighed samples in the batch to be reweighed when the balance meets the acceptance criteria. The data acquisition system will flag any balance check outside the acceptance criteria as code 9984.

FROM Performance Evaluation - The Federal Reference Method (FROM) Performance Evaluation is a quality assurance activity which will be used to evaluate measurement system bias of the PM2.5 monitoring network. The pertinent regulations for this performance evaluation are found in 40 CFR Part 58, Appendix A, section 3.5.3[2]. The strategy is to collocate a portable FROM PM2.5 air sampling instrument with an established routine air monitoring site, operate both monitors in exactly the same manner, and then compare the results of this instrument against the routine sampler at the site. The U.S. EPA will be implementing this program and will inform the ARB when an evaluation will be conducted. The evaluation will be conducted on a regularly scheduled sampling day and the filters from the evaluation instrument will be sent to a national laboratory in Region 10 for measurement. The comparison of data will be accomplished by U.S. EPA personnel using the Aerometric Information Retrieval System (AIRS) data base. It must be noted that the performance evaluation is an estimate of the uncertainty of the measurement system and not the instrument. Therefore, biases may be attributed to sample handling, transportation, and laboratory activities, as well as to the instrument. The statistics used in the assessment are included in 40 CFR Part 58[2].

Corrective Action - The U.S. EPA will notify the ARB of the evaluation results within 10 days of sampling. The bias acceptance criteria for the data comparison is $\pm$10%. If it appears that there is a bias, corrective action will be initiated. The process will include an attempt to determine at what data collection phase(s) the majority of the measurement errors are occurring. This may require that Region IX conduct additional FROM performance evaluations to troubleshoot the process.

Y.14.2 SAMPLE BATCHING

In order to ensure that the ARB can review all types of QC samples within a weighing session, the ARB will use the concept of sample batches. A batch of samples will consist of all routine and QC sample filters weighed in the laboratory on any given day. QC samples will be interspersed within the batch in order to provide data quality information throughout the batch weighing session.

Y.14.3 CONTROL CHARTS

Control charts will be used extensively by the ARB. They provide a graphical means of determining whether various phases of the measurement process are in statistical control. The ARB will utilize property charts which graph single measurements of a standard or a mean of several measurements. The ARB will also develop precision charts which utilize the standard deviation of the measurement process.
Table Y.14.0.3 indicates which QC samples will be control charted. The control charts will be utilized as an "early warning system" to evaluate trends in precision and bias. They will be appropriately filed and archived.

Table Y.14.0.3
Control Charts

QC Check	Plotting technique
Flow rate calibration verification check	single values plotted
Lab/Field Blanks	mean value of each batch
Flow rate audit	single values plotted
Balance check	mean value of each batch
Collocated monitoring pairs	Percent difference each pair charted by site, coefficient of variation each pair, coefficient of variation of all sites per quarter.

References

1. Taylor, J.K. 1987 Quality Assurance of Chemical Measurements. Lewis Publishers, Chelsea, Michigan. 328pp.

2. U.S. EPA (1997b) Revised Requirements for Designation of Reference and Equivalent Methods for PM2.5 and Ambient Air Quality Surveillance for Particulate Matter-Final Rule. 40 CFR Parts 53 and 58. *Federal Register*, **62**(138):38763-38854. July 18, 1997.

Y.15.0 ELEMENT 15 - INSTRUMENT/EQUIPMENT TESTING, INSPECTION, AND MAINTENANCE REQUIREMENTS

Y.15.1 PURPOSE/BACKGROUND

The purpose of this element in the California ARB QAPP is to discuss the procedures used to verify that all instruments and equipment are maintained in sound operating condition and are capable of operating at acceptable performance levels. All instrument inspection and maintenance activities are documented in the ARB's laboratory and field operations SOPs (Appendix B and Appendix E, respectively).

Y.15.2 TESTING

All PM2.5 samplers used in the ARB PM2.5 Ambient Air Quality Monitoring Network will be designated federal reference methods (FRM) that have been certified as such by U.S. EPA. Therefore, they are assumed to be of sufficient quality for the data collection operation. Testing of such equipment is accomplished by U.S. EPA through the procedures described in 40 CFR Part 50[1]. Prior to field installation, ARB will assemble and run the samplers at the acceptance laboratory, adhering to the Acceptance Test procedure in Appendix E. The field operators will perform external and internal leak checks and temperature, pressure and flow rate multi-point verification checks. If any of these checks are out of specification (see Table Y.14.0.1), the ARB will contact the vendor for initial corrective action. Once installed at the site, the field operators will run the tests mentioned above. If the sampling instrument meets the acceptance criteria, it will be assumed to be operating properly. These tests will be properly documented and filed as indicated in Element 9.

Y.15.3 INSPECTION

Inspection of various equipment and components is provided here. Inspections are subdivided into two Elements: one pertaining to weigh room laboratory issues, and one associated with field activities.

Y.15.3.1 <u>INSPECTION IN WEIGH ROOM LABORATORY</u>

There are several items that need routine inspection in the weigh room laboratory. Table Y.15.0.1 details the items to inspect and how to appropriately document the inspection.

Table Y.15.0.1
Inspections in the Weigh Room Laboratory

Item	Inspection Frequency	Inspection Parameter	Action if Item Fails Inspection	Documentation Requirement
Weigh room Temperature	Daily	20 - 23^{O} C	1) Check HVAC System 2) Call *(13th & T Venture)*	1) Document in weigh room log book 2) Notify Lab Manager
Weigh Room Humidity	Daily	30 - 40 %RH	1) Check HVAC System 2) Call *(13th & T Venture)*	1) Document in weigh room log book 2) Notify Lab Manager
Dust in Weigh Room	Monthly	Visually inspect	Clean Weigh Room	Document in Weigh Room log book

Y.15.3.2 INSPECTION OF FIELD ITEMS

There are several items to inspect in the field before and after a PM2.5 sample has been taken. Table Y.15.0.2 details the inspections performed in the field before and after samples are taken.

Table Y.15.0.2
Inspections of Field Items

Item	Inspection Frequency	Inspection Parameter	Action if Item Fails Inspection	Documentation Requirement
Sample downtube	Every site visit	Visible particulate	Clean with a clean dry cloth	Document in log book
WINS Impactor well	Every site visit	“Cone” shape of particulate on impactor well	Replace impactor well (including new impactor oil)	Document in log book
Rain collector	Every site visit	>1/3 full	Empty	Document in log book
O-rings	Every site visit	Any damage	Replace	Document in log book
Filter Cassettes	After each sample run	Visible particulate	Check downtube and WINS impactor	Document in log book
Cassette Seals	Each sample	Clean and smooth	Clean with a clean dry cloth, or replace as needed	Document when replaced
In-line filter	Every 6 months	Loaded particulate	Replace	Document in log book
Battery	Every 6 months	Decrease in voltage	Replace	Document in log book

Y.15.4 MAINTENANCE

There are many items that need maintenance attention in the PM2.5 network. This Element describes those items according to whether they are weigh room items or field items.

Y.15.4.1 WEIGH ROOM MAINTENANCE ITEMS

The successful execution of a preventive maintenance program for the weigh room laboratory will go a long way towards the success of the entire PM2.5 program. In the California ARB PM2.5 network, weigh room laboratory preventive maintenance is handled through the use of two contractors. The building owner, *13th & T Venture*, has a contract to take care of all preventive maintenance associated with the heating, ventilation, and air conditioning system (HVAC). Additionally, *13 & T Venture* can be paged for all emergencies pertaining to the weigh room laboratory HVAC system. Preventive maintenance for the microbalance is performed by the *Quality Control Services* service technician. Preventive maintenance for the microbalance is scheduled to occur at initial set-up and every 12 months thereafter. In the event that there is a problem with the microbalance that cannot be resolved by ARB staff, the *Quality Control Services* service technician can be paged. The service technician will also have a working micro-balance in his/her possession that will be loaned to ARB in case that the ARB's microbalance cannot be repaired on-site. Service contracts with both *13th & T Venture* and *Quality Control Services* are expected to be renewed each year. In the event either company's service agreement is not renewed, a new service provider will be selected and contract put in place. The following table details the weigh room maintenance items, how frequently they will be replaced, and who will be responsible for performing the maintenance.

Table Y.15.0.3
Preventive Maintenance in Weigh Room Laboratories

Item	Maintenance Frequency	Responsible Party
Multi-point Microbalance maintenance calibration	 Yearly Yearly	*Quality Control Services*
Polonium strip replacement	6 Months	Balance Room Analysts
Comparison of NIST Standards to laboratory working and primary standards	Yearly	*Quality Control Services*
Cleaning weigh room	Monthly	Balance Room Analysts
HVAC air filter replacement	Monthly	*13th & T Venture*

Table Y.15.0.3
Preventive Maintenance in Weigh Room Laboratories (cont.)

Clean sticky floor mat (just outside weigh room)	6 Months	Balance Room Analysts
HVAC system preventive maintenance	Yearly	*13th & T Venture*
Computer Back-up	Weekly	LIMS/LAN support personnel
Computer Virus Check	Weekly	LIMS/LAN support personnel
Computer system preventive maintenance (clean out old files, compress hardrive, inspect)	Yearly	LIMS/LAN support personnel

Y.15.4.2 <u>FIELD MAINTENANCE ITEMS</u>

There are many items associated with appropriate preventive maintenance of a successful field program. Table Y.15.0.4 details the appropriate maintenance checks of the PM2.5 samplers and their frequency.

Table Y.15.0.4
Preventive Maintenance of Field Items

Item	Maintenance Frequency	Location Maintenance Performed
Clean WINS PM2.5 Impactor	Every 5 sample episodes	At Lab/Office
Clean PM10 Inlet	Monthly	At Site
Inspect Filter Cassettes	Each run	At Lab
Replace In-line filter	6 Months	At Site
Inspect Air Screens (under sampler's rain hood)	6 Months	At Site
Clean filter holding area, internal and external	Monthly	At Site
Sample Pump Rebuild	Every 10,000 hours of operation	At Lab

References

The following documents were utilized in the development of this Element:

1. U.S. EPA (1997a) National Ambient Air Quality Standards for Particulate Matter - Final Rule. 40 CFR Part 50. *Federal Register*, **62**(138):38651-38760. July 18,1997.

Y.16.0 ELEMENT 16 - INSTRUMENT CALIBRATION AND FREQUENCY

Y.16.1 INSTRUMENTATION REQUIRING CALIBRATION

Y.16.1.1 MASS ANALYSIS BY GRAVIMETRY-LABORATORY MICROBALANCE

The laboratory support for the California ARB includes calibration of the *Sartorius M3P and Sartorius M5P* microbalances. As indicated in Element 13, the balances are calibrated (and mass standard check weights recertified) once a year under a service agreement. The service technician performs routine maintenance and makes any balance response adjustments that the calibration shows to be necessary. During the visit by the service technician, both the in-house primary and secondary (working) standards are checked against the service technician's standards to ensure acceptability. All of these actions are documented in the service technician's report, a copy of which is provided to the laboratory manager, which after review, is appropriately filed (see Element 9).

Y.16.1.2 FLOW RATE-STANDARDS LABORATORY

The ARB Standards Laboratory support performs the comparison of the flow rate transfer standard to a NIST-traceable primary flow rate standard, and once every three years, sends the primary standard to NIST for recertification. The field personnel chose a dry gas meter (DGM) for field calibrations of the Andersen Sequential Sampler and a mass flow meter (MFM) for field calibrations of the R&P Air Sampler. The Vol-O-Flow has been chosen for flow rate verifications of the flow rates of the network samplers. This type of device has the advantage of providing volumetric flow rate values directly, without requiring conversion from mass flow measurements, temperature, pressure, or water vapor corrections. In addition, the mercury-seal piston flowmeter will be used in the Standards Laboratory as a primary standard, where the absence of wind and relatively low humidity will have less negative effect on flowmeter performance.

Upon initial receipt of any new, repaired, or replaced PM 2.5 sampler, field support staff will perform a multipoint flow rate calibration verification on the sampler flow rate to determine if initial performance is acceptable. Once sampler flow rates are accepted, the field personnel performs the calibration and verifications at the frequency specified in Element 14. The Standards Laboratory directly performs or arranges to have another party perform the tests needed to recertify the ARB's standards.

Y.16.1.3 SAMPLER TEMPERATURE, PRESSURE, TIME SENSORS-STANDARDS LABORATORY

The Standards Laboratory arranges support for the field calibration of temperature and pressure sensors by preparing and lab testing the temperature comparison apparatus.

A stationary mercury manometer in the Standards Laboratory is used as a primary standard to calibrate the electronic aneroid barometers that go out in the field as transfer standards.

The Standards Laboratory has also arranged with the NIST@ Time calibration service in Boulder, Colorado, to verify the time on a central lab time device (a specified computer), to which other lab and field devices, including the volumetric flow meter and FRM samplers, are compared.

Y.16.1.4 FIELD

As indicated in Y.16.1.3, the following calibrations are performed in the field:

- calibration of DGM and MFM in FRM samplers against the working standards of DGM and MFM, respectively
- calibration of sampler temperature and pressure sensors against the working temperature standard and working pressure standard
- activation temperature of irreversible thermometer indicators, normally located in the coolers in which filters are transported to and from the sampler in the field, will be verified every six months during semiannual calibration procedures. Activation temperature will be compared to working temperature standard along with Micro 8000 temperature sensor and data logger, which is used on at least a quarterly schedule for QA/QC.

The field equipment and calibration instruments will follow the calibration and recertification schedule as listed in Table Y.16.0.1.

Table Y.16.0.1
Field Equipment Calibration/Certification Schedule

Instrument	Frequency
Andersen Sequential Sampler	Biannual (every 6 months) or if verification check fails
Dry Gas Meter	“
Ambient Temperature Sensor	“
Filter Temperature Sensor	“
Carousel Temperature Sensor	“
DGM Temperature Sensor	“
Ambient Pressure Sensor	“

Table Y.16.0.1
Field Equipment Calibration/Certification Schedule (cont.)

R&P Single Filter Sampler Mass Flow Meter Ambient Temperature Sensor Filter Temperature Sensor Ambient Pressure Sensor	Biannual or if verification check fails “ “ “ “
Calibration Standard DGM Calibration Standard MFM Calibration Standard Temperature Sensor Calibration Standard Tegam (Temperature Calibrator for Andersen) Calibration Standard Pressure Sensor Flow Rate Verification Standard (Vol-O-Flow) Temperature Verification Standard Pressure Verification Standard Clock/Timer Verification Standard	Biannual Every 3 months Annual Annual Annual Annual Annual Annual N/A

Y.16.2 CALIBRATION METHODS

Y.16.2.1 LABORATORY-GRAVIMETRIC (MASS) CALIBRATION

The calibration and QC (verification) checks of the microbalance are addressed in Elements 13.3 and Y.16.1.1 and Appendix B of this QAPP. For the following 3 reasons, the multipoint calibration for this method will be 0, 100 and 200 mg: 1) the required sample collection filters weigh between 100 and 200 mg; 2) the anticipated range of sample loadings for the 24-hour sample period is rarely going to be more than a few 100 Fgs; and 3) the lowest, commercially available check weights that are certified according to nationally accepted standards are only in the single milligram range. Since the critical weight is not the absolute unloaded or loaded filter weight, but the difference between the two, the lack of microgram standard check weights is not considered cause for concern about data quality, as long as proper weighing procedure precautions are taken for controlling contamination or other sources of mass variation in the procedure (see SOP in Appendix B).

Y.16.2.2 LABORATORY (AND FIELD)-FLOW CALIBRATION

Monthly Maintenance QC Checksheets will be submitted to the Air Monitoring managers monthly to ensure QA/QC checks are being performed per scheduled frequencies listed in Tables 6-4 and 7-4 in Elements 6 and 7, respectively.

Method Summary: After equilibrating the calibration device to the ambient conditions of the sampler, install a filter cassette containing an unused 46.2 mm filter in the sampler. After removing the inlet from the sampler, connect the flow calibration device on the sampler down tube. If the sampler has not been calibrated before, or if the previous calibration was not acceptable, perform a leak check according to the manufacturer's operational instruction manual, which is incorporated into the ARB SOP in Appendix E.

Otherwise, place the sampler in calibration mode and perform a three-point calibration/verification or a one-point flow rate verification. The field staff will only perform a leak check after calibration or if verification is outside of the acceptance criteria.

Following the calibration or verification, turn off the sampler pump, remove the filter cassette from the filter cassette holder, remove the flow rate calibration device, (and flow adaptor device if applicable), and replace the sampler inlet. If the flow rate is determined to be outside of the required target flow rate, attempt to determine possible causes by minor diagnostic and trouble shooting techniques (e.g., leak checks), including those listed in the manufacturer's operating instruction manual. Do **not** attempt field repairs or flow rate adjustments.

Y.16.2.3 SAMPLER TEMPERATURE CALIBRATION PROCEDURE

Both the ambient air and filter temperature sensors will be calibrated once per year.

The ambient air sensor is located inside the shielded fixture on the outside of the PM2.5 sampler and is easy to unfasten and remove for comparison to a transfer standard for temperature. The three-point verification/calibration will be conducted at the field site.

The filter temperature sensor is located in the (open) space just below the filter cassette. It is threaded through the walls of the filter cassette holding assembly section of the sampler and removal of plastic or metal fittings is required to remove the sensor and its associated wiring. It may be difficult to calibrate this sensor in the field. Be careful when removing the filter temperature sensor; do not gall the fittings, since this could start an internal leak after the installation. A sampler leak check must be performed after reinstallation of the filter temperature sensor.

Several steps to follow in calibrating the ambient air temperature sensor are given in the SOP in Appendix E and in the following summary. Refer to the operator's instruction manual for sampler-specific procedures and instructions.

Remove the ambient temperature sensor from the radiation shield. Prepare a convenient container (an insulated vacuum wide mouth thermos bottle) for the hot temperature water bath, ambient temperature water bath, and the ice slurry bath. Wrap the sensor(s) and a thermometer together with rubber band, ensure that all the probes are at the same level.

Prepare the ambient or ice slurry solution according to the SOP in Appendix E. Immerse the sensor(s) and the attached thermometer in the ambient temperature bath. Wait at least 5 minutes for the ambient thermal mass and the sensor/thermometer to equilibrate. Wait at least 15 minutes for equilibration with the ice slurry before taking comparative readings.

For each thermal mass, in the order: Ambient, Cold, Ambient, Hot, Ambient, make a series of five measurements, taken about one minute apart. If the measurements indicate equilibrium, average the five readings and record the result as the sensor temperature relative to the thermometer.

A similar process will be used to verify the calibration of continuously-reading temperature sensors used in the laboratory weighing room.

Y.16.2.4 SAMPLER PRESSURE CALIBRATION PROCEDURE. SUMMARIZED HERE AND DETAILED VERSION ATTACHED AS SOP IN APPENDIX E.

General: According to ASTM Standard D 3631 (ASTM 1977), a barometer can be calibrated by comparing it with a secondary standard traceable to a NIST primary standard.

Precautionary Note: Protect all barometers from violent mechanical shock and sudden changes in pressure. A barometer subjected to either of these events must be recalibrated. Maintain the vertical and horizontal temperature gradients across the instruments at less than 0.1EC/m. Locate the instrument so as to avoid direct sunlight, drafts, and vibration.

A Fortin mercury type of barometer is used in the Standards Laboratory to calibrate and verify the aneroid barometer used in the field to verify the barometric sensors of PM2.5 samplers. Details are provided in Y.16.4.1, below, and in Appendix E.

Y.16.2.5 SAMPLER AND STANDARD VOLUMETRIC FLOW RATE SENSORS WITH BUILT-IN CLOCKS

Time can be verified over phone lines from NIST (in Boulder, Colorado, directly or through the NIST calibration service in Gaithersberg, MD). See Appendix B for details (or in NIST standardization handbooks and catalogues).

Y.16.2.6 PROCEDURE FOR VERIFYING RELATIVE HUMIDITY CONTROL/ MONITORING DATA FOR THE FILTER CONDITIONING/WEIGHING ROOM-LABORATORY ONLY

A NIST-traceable thermometer is used by laboratory personnel to verify the temperature and a sling psychrometer is used to verify the relative humidity recorded by the Honeywell weekly chart recorder used to continuously monitor environmental conditions within the weighing room. For details, see Appendix B.

Y.16.3 CALIBRATION STANDARD MATERIALS AND APPARATUS

Table Y.16.0.2 presents a summary of the specific standard materials and apparatus used in calibrating measurement systems for parameters necessary to generate the PM2.5 data required in 40 CFR Part 50, Appendix L, and Part 58.

Table Y.16.0.2
Standard Materials and/or Apparatus for PM2.5 Calibration

Parameter M-Material A=Apparatus	**Std. Material**	**Std. Apparatus**	**Mfr. Name**	**Model #**	**Variable Control Settings**
Mass M	Standard Check weight	NA	*Troemmer*	Class 1	NA
Temperature M+A M+A M+A	 Hg H20 NA	 Thermometer Thermal mass (Thermos) Thermistor	 *Brooklyn* *TBD* *TBD*	 PM TBD TBD	 * NA *
Pressure M+A A	 Hg NA	 Fortin Aneroid	 *TBD*		 * *
Flow Rate A A A A	 NA	 Piston Meter Dry Gas Meter Mass Flow Meter Adapter	 *Brooks, Sierra* *TBD* *TBD* *Andersen, R&P*		 * NA NA
Relative Humidity A	 NA	 Sling Psychrometer	*Environmental Tectronics Corp.*	 Psychro-Dyne	

*- See manufacturer's operating manual and/or instruction sheet

Y.16.4 CALIBRATION STANDARDS

Flow Rate

The flow rate standard apparatus used for flow-rate calibration (field-NIST-traceable, DGM and MFM; Standards Laboratory-NIST-traceable mercury-seal piston flow meter and time monitor) has its own certification and is NIST-traceable. A calibration relationship for the flow-rate standard, such as an equation, curve, or family of curves, is established by the manufacturer (and verified if needed) that is accurate to within 2% over the expected range of ambient temperatures and pressures at which the flow-rate standard is used. The ARB flow rate standard will be recalibrated every three months in the case of the MFM and every six months for the DGM.

The actual frequency with which this recertification process must be completed depends on the type of flow rate standard; some are much more likely to be stable than others. The ARB Standards Laboratory will maintain a control chart (a running plot of the difference or % difference between the flow-rate standard and the NIST-traceable primary flow-rate or volume standard) for all comparisons. In addition to providing excellent documentation of the certification of the standard, a control chart also gives a good indication of the stability of the standard. If the two standard deviation control limits are close together, the chart indicates that the standard is very stable and could be certified less frequently. The minimum recertification frequency is once per year. On the other hand, if the limits are wide, the chart would indicate a less stable standard that will be recertified more often. Also, field staff who conduct field calibrations will track changes from recertification to recertification to assure that performance is not compromised.

Temperature

The operations manuals associated with the single and sequential ARB samplers identify types of temperature standards recommended for calibration and provide a detailed calibration procedure for each type that is specifically designed for the particular sampler.

The U.S. EPA Quality Assurance Handbook, Volume IV (EPA 1995), Section 4.3.5.1, gives information on calibration equipment and methods for assessing response characteristics of temperature sensors.

The temperature standard used for temperature calibration will have its own certification and be traceable to a NIST primary standard. A calibration relationship to the temperature standard (an equation or a curve) will be established that is accurate to within 2% over the expected range of ambient temperatures at which the temperature standard is to be used. The temperature standard must be reverified and recertified at least annually. The actual frequency of recertification depends on the type of temperature standard; some are much more stable than others. The best way to determine recertification requirements is to keep a control chart. The ARB will use an ASTM- or NIST-traceable mercury in glass thermometer, for laboratory calibration.

ARB Standards

The temperature sensor standards chosen by the lab and field staff and managers are based on standard materials contained in standardized apparatus; each has been standardized (compared in a strictly controlled procedure) against temperature standards the manufacturers obtained from NIST.

The ARB laboratory standard is a NIST-traceable glass mercury thermometer from the *Brooklyn Thermometer Company*@, with a certificate summarizing the company's NIST traceability protocol and documenting the technician's signature, comparison date, identification of the NIST standard used, and the mean and standard deviation of the comparison results.

The ARB field temperature standards are thermistor probes and digital readout module with RS232C jack and cable connector available for linkage to a data logger or portable computer. Each probe came with a certificate of NIST-traceability with the same kind of information as the thermometer certificates contained.

Pressure

The Fortin mercurial type of barometer works on fundamental principles of length and mass, and is therefore more accurate but more difficult to read and correct than other types. By comparison, the precision aneroid barometer is an evacuated capsule with a flexible bellows coupled through mechanical, electrical, or optical linkage to an indicator. It is potentially less accurate than the Fortin type but can be transported with less risk to the reliability of its measurements and presents no damage from mercury spills. The Fortin type of barometer is best employed as a higher quality laboratory standard which is used to adjust and certify an aneroid barometer in the laboratory.

Y.16.4.1 STANDARDS LAB

The ARB pressure standard is a Fortin-type mercury barometer.

Y.16.4.2 FIELD

The field working standard is an aneroid barometer with digital readout.

Y.16.5 CALIBRATION FREQUENCY

See Table Y.14.0.1 for a summary of field QC checks that includes frequency and acceptance criteria and references for calibration and verification tests of single and sequential sampler flow rate, temperature, pressure, and time. See Table Y.14.0.2 for a similar summary of laboratory QC, including frequency of primary and working mass standards and conditioning/weighing room temperature and relative humidity.

The field sampler flow rate, temperature and pressure sensor verification checks include one-point checks at least monthly and multipoint checks (verification without adjustment unless needed as determined independently and calibration performed by the vendor's authorized service representative) at least annually, as proven by tracking on control charts.

All of these events, as well as sampler and calibration equipment maintenance will be documented in field data records and notebooks and annotated with the flags required in Appendix L of 40 CFR Part 50, the manufacturer's operating instruction manual and any others indicated in Element 22.7.2 of this document. Laboratory and field activities associated with equipment used by the respective technical staff will be kept in record notebooks as well. The records will normally be controlled by the managers, and located in the labs or field sites when in use or at the manager's offices when being reviewed or used for data validation.

References

1. ASTM. 1977. Standard test methods for measuring surface atmospheric pressure. American Society for Testing and Materials. Philadelphia, PA. Standard D 3631-84.

2. ASTM. 1995. Standard test methods for measuring surface atmospheric pressure. American Society for Testing and Materials. Publication number ASTM D3631-95.

3 EPA (1997a) National Ambient Air Quality Standards for Particulate Matter - Final Rule. 40 CFR Part 50. *Federal Register*, **62**(138):38651-38760. July 18,1997.

4. EPA. 1997b. Ambient air monitoring reference and equivalent methods. U.S. Environmental Protection Agency. 40 CFR Part 53, as amended July 18, 1997.

5. EPA. 1997. Reference method for the determination of fine particulate matter as $PM_{2.5}$ in the atmosphere. U.S. Environmental Protection Agency. 40 CFR Part 58, Appendix L, as amended July 18, 1997.

6. EPA. 1995. Quality Assurance Handbook for Air Pollution Measurement Systems Volume IV: Meteorological Measurements. U.S. Environmental Protection Agency. Document No. EPA/600/ R-94/038d. Revised March.

7. NIST. 1976. Liquid-in-glass thermometry. National Institute of Standards and Technology. NBS Monograph 150. January.

8. NIST. 1986. Thermometer calibration: a model for state calibration laboratories. National Institute of Standards and Technology. NBS Monograph 174. January.

9. NIST. 1988. Liquid-in-glass thermometer calibration service. National Institute of Standards and Technology. Special publication 250-23. September.

10. NIST. 1989. The calibration of thermocouples and thermocouple materials. National Institute of Standards and Technology. Special publication 250-35. April.

Y.17.0 ELEMENT 17 - INSPECTION/ACCEPTANCE FOR SUPPLIES AND CONSUMABLES

Y.17.1 PURPOSE

The purpose of this element is to establish and document a system for inspecting and accepting all supplies and consumables that may directly or indirectly affect the quality of the PM2.5 Program. The California ARB PM2.5 monitoring network relies on various supplies and consumables that are critical to its operation. By having documented inspection and acceptance criteria, consistency of the supplies can be assured. This Element details the supplies/consumables, their acceptance criteria, and the required documentation for tracking this process.

Y.17.2 CRITICAL SUPPLIES AND CONSUMABLES

There are many components to the PM2.5 monitoring network. This Element attempts to describe the needed supplies for this PM2.5 monitoring network and includes items for the weighing room laboratory and the field. Table Y.17.0.1 details the various components:

Table Y.17.0.1
Critical Supplies and Consumables

Area	Item	Description	Vendor	Model Number
Sampler	Impactor Oil	Tetramethyltetraphenyl-trisiloxane (30ml)	Dow Corning	704 Oil
Sampler	37 mm Glass Fiber Filter	For use in impactor well	*To be determined*	
Sampler	Rain Collector	Glass	R & P Anderson	*To be determined* *To be determined*
Sampler	O-Rings	The O-rings that seal in the filter cassette when it is placed in the sampler.	*To be determined*	
Sampler	In-line Filter	Downstream of sample collection and upstream of sample pump.	R & P Anderson	*To be determined* *To be determined*
Sampler	Battery	Internal Sampler Battery.	R & P Anderson	*To be determined* *To be determined*
Sampler	Fuses	In sampler	R & P Anderson	*To be determined* *To be determined*
Sampler	Floppy Disks	3.5" Pre-formatted	Purchase local	

Table Y.17.0.1
Critical Supplies and Consumables (cont.)

Area	**Item**	**Description**	**Vendor**	**Model Number**
Filter	Filters	46.2 mm teflon	Whatman	
Filter	Petri-dish	47 mm with securing ring.	Gelman	7231
Filter	Filter Cassettes (single)	As per CFR design	R & P Anderson	*N/A* *N/A*
Filter	Filter Cassette Holder, Protective Containers	For securing cassette	*To be determined*	*N/A*
Filter	Sequential Sampler Cassette Holder	For use with Anderson Samplers	*To be determined*	*N/A*
Filter	Filter Handling Containers	For transport to and from the field	*To be determined*	*N/A*
Weigh Room	Staticide	Anti-static solution	Cole-Parmer	E-33672-00
Weigh Room	Static Control Strips	Polonium 500FÇ	Nuclear Products	110653
Weigh Room	Air Filters	High Efficiency	Purchase Local	
All	Powder Free Antistatic Gloves	Vinyl, Class M4.5	Fisher Scientific	Small 11-393-85A Medium 11-393-85A Large 11-393-85A X-Large 11-393-85A
All	Low-lint wipes	4.5" x 8.5" Cleaning Wipes	Kimwipes	34155

Y.17.3 ACCEPTANCE CRITERIA

Acceptance criteria must be consistent with overall project technical and quality criteria. Some of the acceptance criteria is specifically detailed in 40 CFR Part 50. Other acceptance criteria, such as observation of damage due to shipping, can only be performed once the equipment has arrived on site.

Table Y.17.0.2 details the acceptance test and limits for procurement of supplies and consumables to be utilized in the PM2.5 ARB network:

Table Y.17.0.2
Acceptance Criteria for Supplies and Consumables

Equipment	Acceptance Criteria	Action if Requirements not met
Impactor Oil	Is the oil identified as Tetramethyltetraphenyl-trisiloxane	Return
37 mm Glass Fiber Filter	Filters of the correct size and quality	Return
Rain Collector	Not broken	Call Vendor, will likely not return
O-Rings	Of the correct size	Return
In-line Filter	Of the correct size	Return
Battery	Correct size and voltage	Return
Fuses	Correct size and specification	Return
Floppy Disks	Undamaged and pre-formatted	Return
Filters, 46.2 mm Teflon	Tested and Accepted by the U.S. EPA with documentation of acceptance in package. Should meet visual inspection and pre-weight (110-160mg) criteria	Call David Lutz, U.S. EPA (919) 541-5476
Petri-dish	Clean and appropriately sized for 46.2 mm filters	Return
Filter Cassettes (single)	Of the correct type and make	Return
Filter Cassette Holder, Protective Containers	Of the correct size so that filter cassettes will not move around that could potentially lead to dislodging particulate	Return
Sequential Sampler Cassette Holder	Of the correct type for use with the sequential sampler model	Return
Filter Handling Containers	Clean	Clean
Anti-Static Solution	Of the correct type	Return
Static Control Strips	Manufactured within past 3 months and between 400 and 500FC$_i$ of Polonium	Call vendor
Air Filters	Of the size and quality specified	Return
Powder Free Antistatic Gloves	Of the size and quality specified	Return
Cleaning Wipes	Of the quality specified	Return

Y.17.4 TRACKING AND QUALITY VERIFICATION OF SUPPLIES AND CONSUMABLES

Tracking and quality verification of supplies and consumables have two main components. The first is the need of the end user of the supply or consumable to have an item of the required quality. The second need is for the purchasing department to accurately track goods received so that payment or credit of invoices can be approved. In order to address these two issues, the following procedures outline the proper tracking and documentation procedures to follow:

1. Receiving personnel will perform a rudimentary inspection of the packages as they are received from the courier or shipping company. Note any obvious problems with a receiving shipment such as crushed box or wet cardboard.

2. The package will be opened, inspected, and contents compared against the packing slip.

3. Supply/consumable will be compared to the acceptance criteria in Table Y.17.0.2.

4. If there is a problem with the equipment/supply, note it on the packing list, notify the supervisor of the receiving area and immediately call the vendor,

5. If the equipment/supplies appear to be complete and in good condition, sign and date the packing list and send to accounts payable so that payment can be made in a timely manner.

6. Notify appropriate personnel that equipment/supplies are available. For items such as the 46.2 mm Teflon filters, it is critical to notify the laboratory manager of the weighing room so sufficient time for de-gassing of the filters can be allowed.

7. Stock equipment/supplies in appropriate pre-determined area.

8. For supplies, consumables, and equipment used throughout the PM2.5 program, document when these items are changed out. If available, include all relevant information such as: model number, lot number, and serial number.

Y.18.0 ELEMENT 18 - DATA ACQUISITION REQUIREMENTS

This Element addresses data not obtained by direct measurement from the PM2.5 Ambient Air Quality Monitoring Program. This includes both outside data and historical monitoring data. Non-monitoring data and historical monitoring data are used by the Program in a variety of ways. Use of information that fails to meet the necessary Data Quality Objectives (DQOs) for the PM2.5 Ambient Air Quality Monitoring Program can lead to erroneous trend reports and regulatory decision errors. The policies and procedures described in this element apply both to data acquired through the California ARB monitoring program and to information previously acquired and/or acquired from outside sources.

Y.18.1 ACQUISITION OF NON-DIRECT MEASUREMENT DATA

The PM2.5 Ambient Air Quality Monitoring Program relies on data that are generated through field and laboratory operations; however, other significant data are obtained from sources outside the ARB or from historical records. This Element lists these data and addresses quality issues related to the PM2.5 Ambient Air Quality Monitoring Program.

Chemical and Physical Properties Data

Chemical and physical and chemical properties data and conversion constants are often required in the processing of raw data into reporting units. This type of information that has not already been specified in the monitoring regulations will be obtained from nationally and internationally recognized sources. The following sources may be used in the PM2.5 Ambient Air Quality Monitoring Program without prior approval:

- National Institute of Standards and Technology (NIST)
- ISO, IUPAC, ANSI, and other widely-recognized national and international standards organizations
- U.S. EPA
- The current edition of certain standard handbooks may be used without prior approval. Two that are relevant to the fine particulate monitoring program are CRC Press' *Handbook of Chemistry and Physics*, and *Lange's Handbook.*

Geographic Location

Another type of data that will commonly be used in conjunction with the PM2.5 Ambient Air Quality Monitoring Program is geographic information. For the current sites, the ARB will locate these sites using global positioning systems (GPS).

Historical Monitoring Information of the California ARB

The ARB has operated a network of ambient air monitoring stations since the 1980's.

Historical monitoring data and summary information derived from that data may be used in conjunction with current monitoring results to calculate and report trends in pollutant concentrations. In calculating historical trends, it is important to verify that historical data are fully comparable to current monitoring data. If different methodologies were used to gather the historical data, the biases and other inaccuracies must be described in trends reports based on that data. Direct comparisons of PM2.5 with historical TSP or PM10 data will not be reported or used to estimate trends. Dichot sampler data (fine portion) may be used to establish trends in PM2.5 concentration; however, evidence must be presented to demonstrate that results of the two methods are comparable.

External Monitoring Data Bases

It is the policy of the ARB that no data obtained from any other organization or agency shall be used in creating published reports or regulatory actions unless the data were collected under a QA program that meets the requirements of 40 CFR Part 58, and has been approved by the ARB's Quality Assurance Section Manager. Such data that have received this approval may be entered into AIRS.

Data from the U.S. EPA AIRS data base may be used in published reports with appropriate caution. Care must be taken in reviewing/using any data that contain flags or data qualifiers. If data is flagged, such data shall not be utilized unless it is clear that the data still meets critical QA/QC requirements. It is impossible to assure that a data base such as AIRS is completely free from errors including outliers and biases, so caution and skepticism is called for in comparing ARB data from other reporting agencies as reported in AIRS. Users should review available QA/QC information to assure that the external data are comparable with ARB measurements and that the original data generator had an acceptable QA program in place.

Lead and Speciated Particulate Data

The ARB has been routinely monitoring airborne lead, as collected in total suspended particulates (TSP), since the 1980's. However, caution is needed in directly comparing this data with the PM2.5 data because of the difference in size fractions.

Existing chemical speciation data for ions and for elements other than lead are also very extensive. Speciation data (30 elements, by XRF analysis) from dichot samples has been obtained by the ARB for approximately 20 monitoring locations since 1989 for 10 sites of the Dry Acid Deposition monitoring network. These results may be used to provide a historical baseline for the speciation results to be obtained by the PM2.5 Ambient Air Quality Monitoring Program; however, it is unclear whether the quality of these data are sufficient to allow direct comparison with new data.

Meteorological Data From Other Sources

Meteorological data are gathered from other sources such as the U.S. Weather Service sites to provide information required when developing monitoring sites, computing corrections needed to convert from standard conditions to local conditions, and to support analysis and modeling efforts. These data are not reported to AIRS and are clearly identified when used in assessment and modeling efforts.

Y.19.0 ELEMENT 19 - DATA MANAGEMENT

Y.19.1 BACKGROUND AND OVERVIEW

This Element describes the data management operations pertaining to PM2.5 measurements for the SLAMS/NAMS stations operated by the California ARB. This includes an overview of the mathematical operations and analyses performed on raw (“as-collected”) PM2.5 data. These operations include data recording, validation, transformation, transmittal, reduction, analysis, management, storage, and retrieval.

Data processing for PM2.5 data are summarized in Figure Y.19.0.1. Data processing steps are integrated, to the extent possible, into the existing data processing system used for the ARB’s SLAMS network. All sampling data will be entered into a Laboratory Information Management System (LIMS) either through manual entry, electronic transfer from the field, or both. The LIMS data is stored on an Oracle database running on a Sun platform and interfaced with software by Perkin-Elmer Nelson called SQL*LMS. All PM2.5 mass and speciated results will be electronically transferred from the analytical instruments into LIMS, where the final concentrations are calculated. The LIMS runs on the laboratory’s network and is accessible by all chemists and management. Appropriate security is assigned to each individual. This platform is shown in the upper left of Figure Y.19.0.1.

Each Ambient Air Monitoring Station operated by the ARB has an Environmental Systems Corporation data logger. These data loggers provide data collection for continuous analyzers at each station. There are currently no facilities to remotely acquire the PM2.5 sampler data. However, the ARB is examining the possibility of upgrading these stations in the future so that sampler status, flow rate, temperatures, etc., can be monitored remotely.

Filter tracking and chain of custody information are entered into the PM2.5 LIMS at four main stages as shown in Figure Y.19.0.1. Managers are able to obtain reports on status of samples, location of specific filters, etc. using the LIMS. All users must be authorized by the Manager of the Inorganics Laboratory Section (ILS), and receive a password necessary to log on to the LIMS. Different privileges are given each authorized user depending on that person's need. The following privilege levels are defined:

- **Data Entry Privilege** - The individual may see and modify only data within the PM2.5 LIMS datagroup that he or she has personally entered. After a data set has been "committed" to the system by the data entry operator, all further changes will generate entries in the system audit trail. After the results are “approved” by management, only the Data Administrator can perform changes.

- **Reporting Privilege** - This privilege permits generation of data summary reports available under the Oracle Developer 2000 software. No data changes are allowed.
- **Data Administration Privilege** - Data Administrators for the PM2.5 LIMS are allowed to change data as a result of QA screening and related reasons. All operations resulting in changes to data values are logged to the audit trail. The Data Administrator is responsible for performing the following tasks on a regular basis:

  - merging/correcting the duplicate data entry files
  - running verification and validation routines and correcting data as necessary
  - generating summary data reports for management
  - uploading verified/validated data to U.S. EPA AIRS

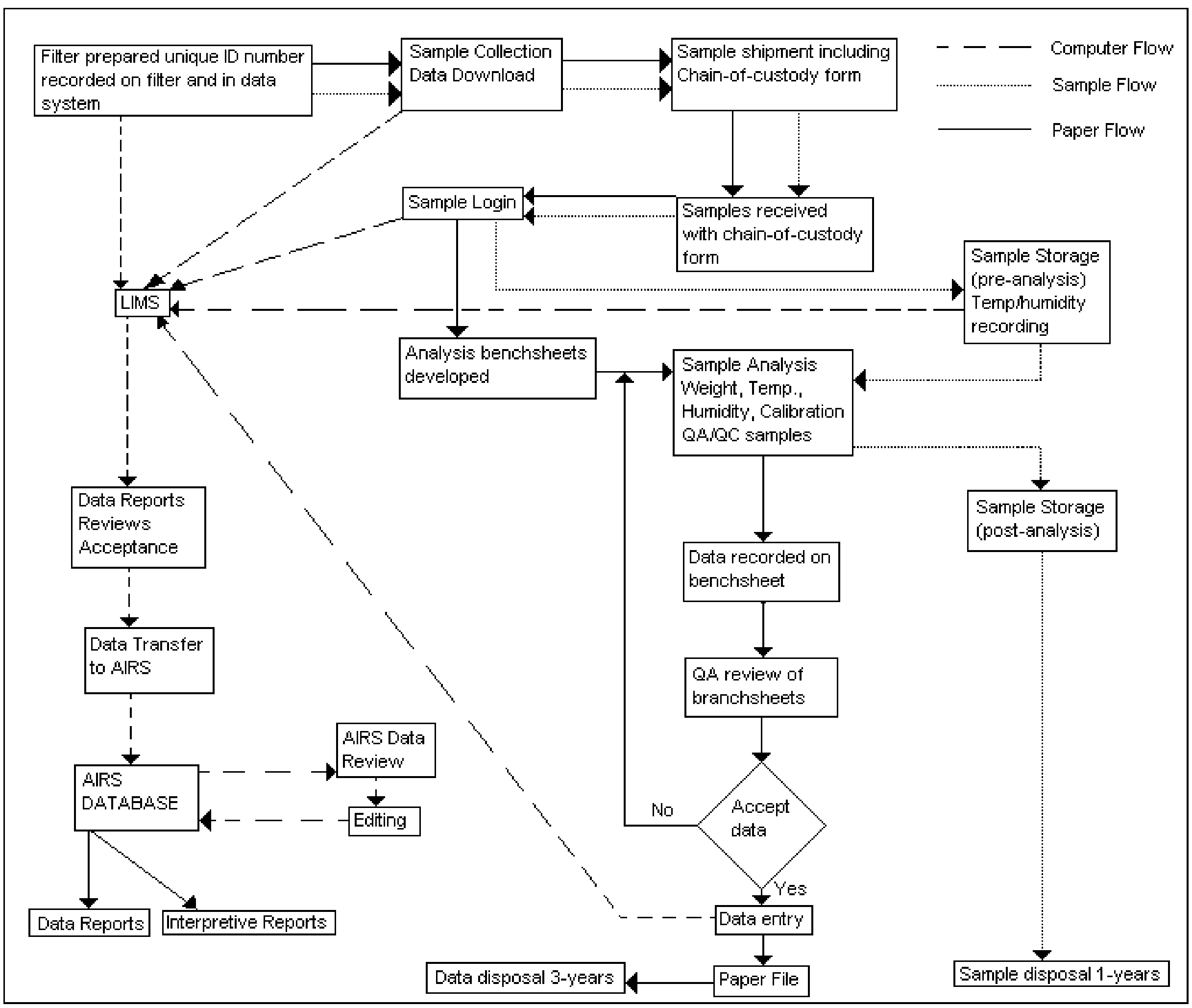

Figure 19.0.1
Draft PM2.5 Data Flow Diagram

Y.19.2 DATA RECORDING

Data entry, validation, and verification functions are all integrated in the LIMS. Bench sheets shown in Figure Y.19.0.1 are entered by laboratory personnel. Procedures for filling out the laboratory sheets and subsequent data entry are provided in SOPs listed in Appendix B.

Y.19.3 DATA VALIDATION

Data validation involves checking that data processing operations have been carried out correctly and monitoring the quality of the field operations. Data validation can identify problems in either of these areas. Once problems are identified, the data can be corrected or invalidated, and corrective actions can be taken for field or laboratory operations. Numerical data stored in the LIMS are never internally overwritten by condition flags. Flags denoting error conditions or QA status are saved as separate fields in the data base, so that it is possible to recover the original data.

The following validation functions are incorporated into the LIMS to ensure quality of data entry and data processing operations:

- **Duplicate Key Entry** - the following data are subjected to duplicate entry by different operators: filter weight reports, field data sheets, chain of custody sheets. The results of duplicate key entry are compared and errors are corrected at monthly intervals.
- **Range Checks** - almost all monitored parameters have simple range checks programmed in. For example, valid times must be between 00:00 and 23:59, summer temperatures must be between 10 and 50 degrees Celsius, etc. The data entry operator is notified immediately when an entry is out of range. The operator has the option of correcting the entry or overriding the range limit. The specific values used for range checks may vary depending on season and other factors. Since these range limits for data input are not regulatory requirements, they may be adjusted from time to time to better meet quality goals.
- **Completeness Checks** - When the data are processed, certain completeness criteria must be met. For example, each filter must have a start time, an end time, an average flow rate, dates weighed, and operator and technician names. The data entry operator will be notified if an incomplete record has been entered before the record can be closed.
- **Internal Consistency and Other Reasonableness Checks -** Several other internal consistency checks are built into the LIMS. For example, the end time of a filter must be greater than the start time. Computed filter volume (integrated flow) must be approximately equal to the exposure time multiplied by the nominal flow. Additional consistency and other checks will be implemented as the result of problems encountered during data screening.

< **Data Retention** - Raw data sheets are retained on file in the MLD office for a minimum of five years, and are readily available for audits and data verification activities. After five years, hardcopy records and computer backup media are cataloged and boxed for storage. Physical samples, such as filters, shall be discarded with appropriate attention to proper disposal of potentially hazardous materials.

< **Statistical Data Checks** - Errors found during statistical screening will be traced back to original data entry files and to the raw data sheets, if necessary. These checks shall be run on a monthly schedule and prior to any data submission to AIRS. Data validation is the process by which raw data are screened and assessed before it can be included in the main data base (i.e., the LIMS).

< **Sample Batch Data Validation**- which is discussed in Element 23, associates flags that are generated by QC values outside of acceptance criteria with a sample batch. Batches containing more than one flag may be rerun and/or invalidated.

Table Y.19.0.1 Summarizes the Validation Checks Applicable to the PM2.5 Data.

Table Y.19.0.1
Validation Check Summaries

Type of Data Check	Electronic Transmission and Storage	Manual Checks	Automated Checks
Data Parity and Transmission Protocol Checks	U		
Duplicate Key Entry		U	
Date and Time Consistency	U	U	U
Completeness of Required Fields	U	U	U
Range Checking	U	U	U
Statistical Outlier Checking	U		U
Manual Inspection of Charts and Reports		U	
Sample Batch Data Validation	U		U

Two key operational criteria for PM2.5 sampling are bias and precision. As defined in 40 CFR Part 58, Appendix A, these are based on differences between collocated sampler results and FRM performance evaluations. The ARB's MLD ILS will inspect the results of collocated sampling during each batch validation activity. This data will be evaluated as early in the process as possible, so that potential operational problems can be addressed. The objective of the ARB will be to optimize the performance of its PM2.5 monitoring equipment. Initially, the results of collocated operations will be control charted (see Element 14). From these charts, control limits will be established to flag potential problems. Multiple collocation results must be accumulated to assess data quality with confidence. However, even limited data can be used for system maintenance and corrective action.

Y.19.4 DATA TRANSFORMATION

Calculations for transforming raw data from measured units to final concentrations are relatively straightforward, and many are carried out in the sampler data processing unit before being recorded. The following relations in Table Y.19.0.2 pertain to PM2.5 monitoring:

Table Y.19.0.2
Raw Data Calculations

Parameter	Units	Type of Conversion	Equation
Filter Volume (V_a) *	m^3	Calculated from average Flow Rate (Q_{ave}) in L/min, and total elapsed time (t) in min. multiplied by the unit conversion (m^3/L)	$V_a \ ' \ Q_{ave} \times t \times 10^{\&3} m^3/L$
Mass on Filter ($M_{2.5}$)	Fg	Calculated from filter post-weight (M_f) in mg and filter pre-weight (M_i) in mg, multiplied by the unit conversion (Fg/mg)	$M_{2.5} \ ' \ (M_f \ \& \ M_i) \times 10^3$
$PM_{2.5}$ Concentration ($C_{PM2.5}$)	Fg/ m^3	Calculated from laboratory data and sampler volume	$PM_{2.5} \ ' \ \frac{M_{2.5}}{V_a}$

* - most FRM instruments will provide this value from the data logger.

Y.19.5 DATA TRANSMITTAL

Data transmittal occurs when data are transferred from one person or location to another or when data are copied from one form to another. Some examples of data transmittal are copying raw data from a notebook onto a data entry form for keying into a computer file and electronic transfer of data over a telephone or computer network. Table Y.19.0.3 summarizes data transfer operations.

Table Y.19.0.3
Data Transfer Operations

Description of Data Transfer	Originator	Recipient	QA Measures Applied
Keying Weighing Data into The LIMS	Laboratory Technician (hand-written data form)	Data Processing Personnel	Double Key Entry
Electronic data transfer	(between computers or over network)	--	Parity Checking; transmission protocols
Filter Receiving and Chain-of-Custody	Shipping and Receiving Clerk	The LIMS Computer (shipping clerk enters data at a local terminal)	Filter numbers are verified automatically; reports indicate missing filters and/or incorrect data entries
AIRS data summaries	Data Administrator	AIRS (U.S. EPA)	ILS Manager

The ARB will report all PM2.5 ambient air quality data and information specified by the AIRS Users Guide (Volume II, Air Quality Data Coding, and Volume III, Air Quality Data Storage), coded in the AIRS-AQS format. Such air quality data and information will be fully screened and validated and will be submitted directly to the AIRS-AQS via electronic transmission, in the format of the AIRS-AQS, and in accordance with the quarterly schedule. The specific quarterly reporting periods and due dates are shown in the Table Y.19.0.4.

Table Y.19.0.4
Data Reporting Schedule

Reporting Period	**Due Date**
January 1-March 31	June 30
April 1-June 30	September 30
July 1-September 30	December 31
October 1-December 31	March 31

Y.19.6 DATA REDUCTION

Data reduction processes involve aggregating and summarizing results so that they can be understood and interpreted in different ways. The PM2.5 monitoring regulations require certain summary data to be computed and reported regularly to U.S. EPA. Other data are reduced and reported for other purposes such as station maintenance. Examples of data summaries include:

- average PM2.5 concentration for a station or set of stations for a specific time period
- accuracy, bias, and precision statistics based on accumulated FROM/FEM data
- data completeness reports based on numbers of valid samples collected during a specified period

The Audit Trail is another important concept associated with data transformations and reductions. An audit trail is a data structure that provides documentation for changes made to a data set during processing. Typical reasons for data changes that would be recorded include the following:

- corrections of data input due to human error
- application of revised calibration factors
- addition of new or supplementary data
- flagging of data as invalid or suspect
- logging of the date and times when automated data validation programs are run

The LIMS audit trail is implemented in the Oracle data base. Audit trail records will include the following fields:

- operator's identity (ID code)
- date and time of the change
- table and field names for the changed data item
- reason for the change
- full identifying information for the item changed (date, time, site location, parameter, etc.)
- value of the item before and after the change

When routine data screening programs are run, the following additional data are recorded in the audit trail:

- version number of the screening program
- values of screening limits (e.g., upper and lower acceptance limits for each parameter)
- numerical value of each data item flagged and the flag applied

The audit trail is produced automatically and can only document changes; there is no "undo" capability for reversing changes after they have been made. Available reports based on the audit trail include:

- log of routine data validation, screening, and reporting program runs
- report of data changes by station for a specified time period
- report of data changes for a specified purpose
- report of data changes made by a specified person

Because of storage requirements, the Data Administrator must periodically move old audit trail records to backup media. Audit trail information will not be moved to backup media until after the data are reported to AIRS. All backups will be retained so that any audit trail information can be retrieved for at least three years.

Y.19.7 DATA ANALYSIS

The ARB is currently implementing the data summary and analysis requirements contained in 40 CFR Part 58, Appendix A. It is anticipated that as the PM2.5 Monitoring Program develops, additional data analysis procedures will be developed. The following specific summary statistics will be tracked and reported for the PM2.5 network:

- Single sampler bias or accuracy (based on collocated FRM data, flow rate performance audits, and FRM performance evaluations)
- Single sampler precision (based on collocated data)
- Network-wide bias and precision (based on collocated FRM data, flow rate performance audits, and FRM performance evaluations)
- Data completeness

Equations used for these reports are given in the Table Y.19.0.5.

Table Y.19.0.5
Report Equations

Criterion	Equation	Reference
Accuracy of Single Sampler Flow - Single Check (d_i) X_i is reference flow; Y_i is measured flow	$d_i = \frac{Y_i - X_i}{X_i} \times 100$	40 CFR 58 Appendix A, Section 5.5.1.1
Bias of a Single Sampler - Annual Basis (D_j)- average of individual percent differences between sampler and reference value; n_j is the number of measurements over the period	$D_j = \frac{1}{n_i} \times \sum_{i=1}^{n_j} d_i$	5.5.1.2
Percent Difference for a Single Check (d_i) - X_i and Y_i are concentrations from the primary and duplicate samplers, respectively.	$d_i = \frac{Y_i - X_i}{(Y_i + X_i)/2} \times 100$	5.5.2.1
Coefficient of Variation (CV_i) for a single Check	$CV_i = \frac{\lvert d_i \rvert}{\sqrt{2}}$	5.5.2.2
Pooled Coefficient of Variation, Quarterly Basis ($CV_{j,q}$). The CV_i will only be used when the two measurements are both greater than 6 µg/m3.	$CV_{j,q} = \sqrt{\sum_{i=1}^{n_j} \frac{CV_i^2}{n_{j,q}}}$	5.5.2.3 (a)
Completeness	$\text{Completeness} = \frac{N_{valid}}{N_{theoretical}} \times 100$	--

Y.19.8 DATA FLAGGING -SAMPLE QUALIFIERS

A sample qualifier or a result qualifier consists of three or four alphanumeric characters which act as an indicator of the fact and the reason that the data value: (a) did not produce a numeric result, (b) produced a numeric result but it is qualified in some respect relating to the type or validity of the result, or (c) produced a numeric result but for administrative reasons is not to be reported outside the laboratory. Qualifiers will be used both in the field and in the laboratory to signify data that may be suspect due to contamination, special events, or failure of QC limits. Some flags will be generated by the sampling instrument (see Table Y.6.0.2). Appendix C contains a complete list of the data qualifiers for the field and laboratory activities. Qualifiers will be placed on field and bench sheets, with additional explanations in free-form notes areas. When sample batch information is entered into LIMS and the validation process run (see Element 23), flags will be generated. Table Y.19.0.6 lists the sample batch flags that will be generated by the LIMS.

Table Y.19.0.6
Sample Batch Quality Control Flags

Requirement	Acceptance Criteria	Flag
Blanks		
Field Blanks	±30 Fg difference	FFB
Lab Blanks	±15 Fg difference	9984
Precision Checks		
Laboratory Duplicate	±15 Fg	9984
Accuracy		
Balance Check	≤3 Fg	9984

During the sample validation process, the flags will be used to decide on validating or invalidating individual samples or batches of data. Element 23 discusses this process.

There are several other flags associated with laboratory operations. See Appendix C for a complete list of data qualifiers/flags.

Y.19.9 DATA TRACKING

The LIMS and Oracle Developer 2000 software contain the necessary input functions and reports necessary to track and account for the whereabouts of filters and the status of data processing operations for specific data. Information about filter location is updated at distributed data entry terminals at the points of significant operations. The following input locations are used to track filter location and status:

< Laboratory

  C Filter receipt (by lot)
  C Filter pre-sampling weighing (individual filter number first enters the system)
  C Filter packaged for the laboratory (filter numbers in each package are recorded)

< Shipping (package numbers are entered for both sending and receiving)
< Laboratory

- Package receipt (package is opened and filter numbers are logged in)
- Filter post-sampling weighing
- Filter archival

Tracking reports may be generated by any personnel with report privileges on the Oracle Developer 2000 software. The following tracking reports are available:

- Location of any filter (by filter number)
- List of all filters sent to a specified site that have not been returned
- List of all filters that have not been returned and are more than 30 days past initial weighing date
- List of all filters in the filter archive
- List of all filters that have been received but have not been post-weighed
- Ad hoc reports can also be generated using SQL queries

The ILS Manager or designee is responsible for tracking filter status at least twice per week and following up on anomalies such as excessive holding time in the laboratory before reweighing.

Y.19.10 DATA AND FILTER STORAGE AND RETRIEVAL

Data and filter archive policies for the PM2.5 data are shown in Table Y.19.0.7.

Table Y.19.0.7
Data and Filter Archive Policies

Data Type	**Medium**	**Location**	**Retention Time**	**Final Disposition**
Weighing records; chain of custody forms	Hardcopy	Laboratory	3 years	Discarded
Laboratory Notebooks	Hardcopy	Laboratory	3 years	N/A
Field Notebooks	Hardcopy	Air Quality Surveillance Branch	3 years	Discarded
PM2.5 MP Data Base (excluding Audit Trail records)	Electronic (on-line)	Technical Support Division and MLD	indefinite (may be moved to backup media after 5 years)	Backup tapes retained indefinitely
PM2.5 MP Audit Trail records	Electronic (backup tapes)	Quality Assurance Section	3 years	Discarded
Filters	Filters	Laboratory	1 year	Discarded

The PM2.5 data reside on a Sun Sparc Server in the MLD. This computer has the following specifications:

< Processor: Sun Sparc 20
< Operating System: Solaris (Unix)
< Memory: 128 MB
< Storage: 2 2.3 GB (SCSI)
< Backup: DAT (3 GB per tape) - 8 mm DAT (8 GB) - Monday, Wednesday, Friday incrementals; full backup monthly
< Network: NT 4.0, 10 base T (GTP)
< Data Base Software: Oracle
< Security: Password protection on all workstations and dial-in lines; Additional password protection applied by application software

Security of data in the PM2.5 data base is ensured by the following controls:

< Password protection on the data base that defines three levels of access to the data
< Regular password changes (quarterly for continuing personnel; passwords for personnel leaving will be canceled immediately)
< Independent password protection on all dial-in lines
< Logging of all incoming communication sessions, including the originating telephone number, the user's ID, and connect times
< Storage of media including backup tapes in locked, restricted access areas

Y.20.0 ELEMENT 20 - ASSESSMENTS AND RESPONSE ACTIONS

An assessment, for this QAPP, is defined as an evaluation process used to measure the performance or effectiveness of the quality system, the establishment of the monitoring network and sites, and various measurement phases of the data operation.

The results of quality assurance assessments indicate whether the control efforts are adequate or need to be improved. Documentation of all quality assurance and quality control efforts implemented during the data collection, analysis, and reporting phases is important to data users, who can then consider the impact of these control efforts on the data quality (see Element 21). Both qualitative and quantitative assessments of the effectiveness of these control efforts will identify those areas most likely to impact the data quality and to what extent. Periodic assessments of SLAMS data quality are required to be reported to U.S. EPA. On the other hand, the selection and extent of the QA and QC activities used by a monitoring agency depend on a number of local factors, such as the field and laboratory conditions, the objectives for monitoring, the level of the data quality needed, the expertise of assigned personnel, the cost of control procedures, pollutant concentration levels, etc.

In order to ensure the adequate performance of the quality system, the California ARB will perform the following assessments:

- Management Systems Reviews
- Network Reviews
- Systems Audits
- Field and Laboratory Performance Audits
- Data Quality Assessments

Y.20.1 ASSESSMENT ACTIVITIES AND PROJECT PLANNING

Y.20.1.1 MANAGEMENT SYSTEMS REVIEW

A management systems review (MSR) is a qualitative assessment of a data collection operation or organization to establish whether the prevailing quality management structure, policies, practices, and procedures are adequate for ensuring that the type and quality of data needed are obtained. ARB's internal commitment to QA/QC, system audits, performance audits, network reviews, precertification, data management and reporting, and corrective action activities will collectively serve as a MSR. The quality control and assessment activities that collectively represent the MSR will use appropriate federal regulations and the ARB's QAPP to determine the adequate operation of the PM2.5 program and its related quality system. The divisions to be included in the qualitative assessment include the ARB's Monitoring and Laboratory and Planning and Technical

Support Divisions. ***IN ADDITION, AN INDEPENDENT MSR OF STATE-WIDE QA PROGRAM IMPLEMENTATION WILL BE PROVIDED BY U.S. EPA.*** The MSRs will be appropriately filed (Element 9). Follow-up and progress on corrective action(s) will be determined during regularly scheduled division meetings.

Y.20.1.2 NETWORK REVIEWS

Conformance with network requirements of the Ambient Air Monitoring Network set forth in 40 CFR Part 58; Appendices D and E are determined through annual network reviews of the ambient air quality monitoring system. The network review is used to determine how well a particular air monitoring network is achieving its required air monitoring objective, and how it should be modified to continue to meet its objective. A PM2.5 Network review will be accomplished every year. Since the U.S. EPA Regions are also required to perform these reviews, the ARB will coordinate its activity with Region IX in order to perform the activity at the same time (if possible). The ARB's PTSD Air Quality Data Review Section will be responsible for conducting the network review.

The following criteria will be considered during the review:

< date of last review
< areas where attainment/nonattainment redesignations are taking place or are likely to take place
< results of special studies, saturation sampling, point-source oriented ambient monitoring, etc.
< proposed network modifications since the last network review

In addition, pollutant-specific priorities may be considered (e.g., newly designated nonattainment areas, "problem areas", etc.).

Prior to the implementation of the network review, significant data and information pertaining to the review will be compiled and evaluated. Such information might include the following:

< network files (including updated site information and site photographs)
< AIRS reports (AMP220, 225, 380, 390, 450)
< air quality summaries for the past five years for the monitors in the network
< emissions trends reports for major metropolitan areas
< emission information, such as emission density maps for the region in which the monitor is located and emission maps showing the major sources of emissions
< National Weather Service summaries for monitoring network area

Upon receiving the information, it will be checked to ensure it is the most current. Discrepancies will be noted on the checklist and resolved during the review. Files and/or photographs that need to be updated will also be identified. The following categories will emphasized during network reviews:

Number of Monitors - For SLAMS, the number of monitors required for PM2.5 depending upon the measurement objectives is discussed in 40 CFR Part 58 with additional details in the *Guidance for Network Design and Optimum Exposure for PM2.5 and PM10* . Element 10 of this QAPP discusses the PM2.5 Network. Adequacy of the network will be determined by using the following information:

< maps of historical monitoring data
< maps of emission densities
< dispersion modeling
< special studies/saturation sampling
< best professional judgement
< SIP requirements
< revised monitoring strategies (e.g., lead strategy, reengineering air monitoring network)

For NAMS, areas to be monitored must be selected based on urbanized population and pollutant concentration levels. To determine whether the number of NAMS are adequate, the number of NAMS operating will be compared to the number of NAMS specified in 40 CFR Part 58, Appendix D. The number of NAMS operating can be determined from the AMP220 report in AIRS. The number of monitors required, based on concentration levels and population, can be determined from the AMP450 report and the latest census population data.

Location of Monitors - For SLAMS, the location of monitors is not specified in the regulations, but is determined by the Regional Office and State agencies on a case-by-case basis to meet the monitoring objectives specified in 40 CFR Part 58, Appendix D. Adequacy of the location of monitors can only be determined on the basis of stated objectives. Maps, graphical overlays, and GIS-based information will be helpful in visualizing or assessing the adequacy of monitor locations. Plots of potential emissions and/or historical monitoring data versus monitor locations will also be used.

During the network review, the stated objective for each monitoring location or site (see Element 10) will be “reconfirmed” and the spatial scale “reverified” and then compared to each location to determine whether these objectives can still be attained at the present location.

Conformance to 40 CFR Part 58 Appendix E - Probe Siting Requirements - Applicable siting criteria for SLAMS and NAMS are specified in 40 CFR Part 58, Appendix E. The on-site visit will consist of the physical measurements and observations to determine compliance with the Appendix E requirements, such as height above ground level, distance from trees, paved or vegetative ground cover, etc. Since many of the

Appendix E requirements will not change within one year, this check at each site will be performed as part of a site survey each time the site is visited.
Prior to the site visit, the reviewer will obtain and review the following:

< most recent hard copy of site description (including any photographs)
< data on the seasons with the greatest potential for high concentrations for specified pollutants
< predominant wind direction by season

A checklist similar to the checklist used by the U.S. EPA Regional offices during their scheduled network reviews will be used. This checklist can be found in the *SLAMS/NAMS/PAMS Network Review Guidance* which is intended to assist the reviewers in determining conformance with Appendix E. In addition to the items on the checklist, the reviewer will also perform the following tasks:

< ensure that the inlet is clean
< check equipment for missing parts, frayed cords, damage, etc.
< record findings in field notebook and/or checklist
< take photographs/videotape in 8 directions (at 45E intervals from North, clockwise)
< document site conditions, with additional photographs/videotape

Other Discussion Topics - In addition to the items included in the checklists, other subjects for discussion as part of the network review and overall adequacy of the monitoring program will include:

< installation of new monitors
< relocation of existing monitors
< siting criteria problems and suggested solutions
< problems with data submittals and data completeness
< maintenance and replacement of existing monitors and related equipment
< air quality assurance problems
< air quality studies and special monitoring programs
< other issues
-proposed regulations
-funding

A report of the network review will be written within two months of the review (Element 21) and appropriately filed (Element 10).

Y.20.1.3 SYSTEM AUDITS

A system audit is a thorough and systematic onsite qualitative audit, where facilities, equipment, personnel, training, procedures, and record keeping are examined for conformance to the QAPP. The ARB's Quality Assurance Section (QAS) will conduct the system audit either as a team or as an individual auditor. The QAS will perform three system audit activities that can be accomplished separately or combined:

- Field - handling, sampling, shipping
- Laboratory - Presampling weighing, shipping, receiving, postsampling weighing, archiving, and associated QA/QC
- Data management - Information collection, flagging, data editing, security, upload

Key personnel to be interviewed during the audit are those individuals with responsibilities for: planning, field operations, laboratory operations, QA/QC, data management, and reporting. The audit activities are illustrated in Figure 20.0.1.

To ensure uniformity of the system audit, an audit checklist will be developed and used. The audit team will discuss deficiencies with key personnel during the debriefing. They will be informed of any air quality data actions (AQDA) that will be issued for deficiencies which may require data invalidation.

The QAS will send a copy of the final system audit report to U.S. EPA Region IX. Any corrective action taken will be included in the report.

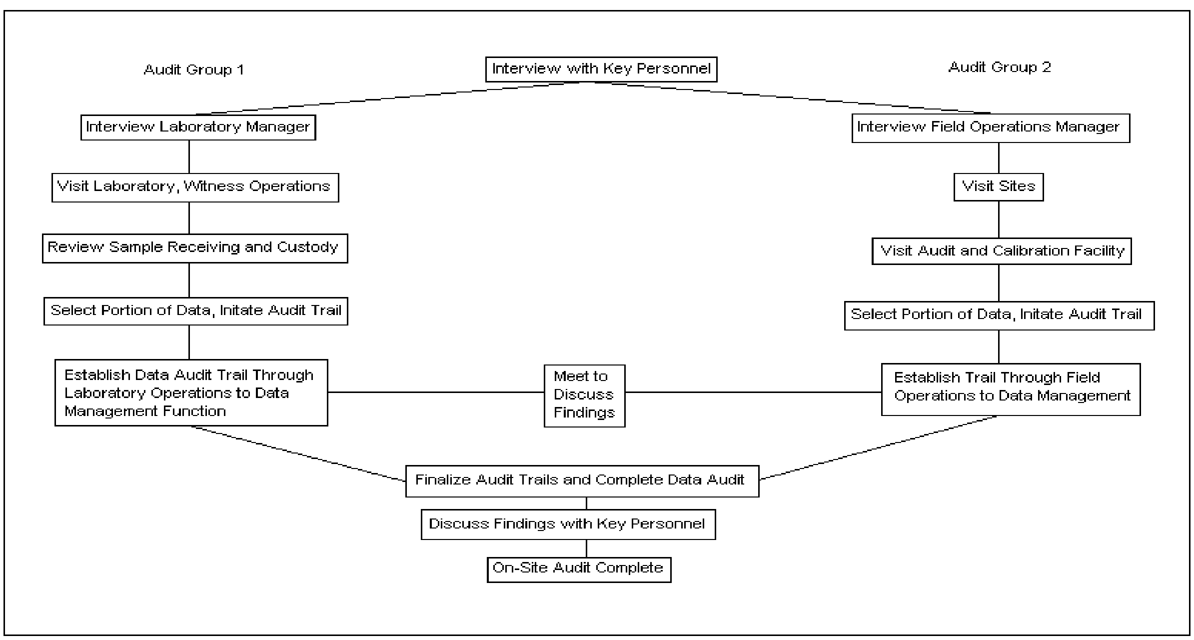

Figure 20.0.1
Audit Activities

Post-Audit Activities - The major post-audit activity is the preparation of the system audit report. The report will include:

- audit title and any other identifying information
- audit team leaders, audit team participants, and audited participants
- background information about the project, purpose of the audit, dates of the audit, particular measurement phase or parameters that were audited, and a brief description of the audit process
- summary and conclusions of the audit and corrective action required
- attachments or appendices that include all audit evaluations and audit finding forms

To prepare the report, the audit team will meet and compare observations with collected documents and results of interviews and discussions with key personnel. Expected QA Project Plan implementation is compared with observed accomplishments and deficiencies and the audit findings are reviewed in detail. The system audit report will be submitted to the appropriate departments or agencies.

If the departments or agencies have written comments or questions concerning the audit report, the Audit Team will review and incorporate them as appropriate, and subsequently prepare and resubmit a report in final form following receipt of the written comments. The report will include an agreed-upon schedule for corrective action implementation.

Follow-up and Corrective Action Requirements - The QAS and the audited organization may work together to solve required corrective actions. The audited organization has 30 days to respond to the follow-up and corrective action requirements in the system audit report. The QAS reviews the audited organization's responses to the follow-up and corrective action and works with the audited agency to resolve any discrepancies.

Y.20.1.4 FIELD AND LABORATORY PERFORMANCE AUDITS

Field and laboratory performance audits reveal how the data are handled, what judgments were made, and whether uncorrected mistakes were made. The audits can often identify the means to correct systematic data reduction errors. The audits will be performed every year and will also be part of the system audit. Thus, sufficient time and effort will be devoted to this activity so that the auditor or team has a clear understanding and complete documentation of data flow. Pertinent audit questions will appear on the system audit check sheets to ensure that the data collected at each stage maintains its integrity. The audits will serve as an effective framework for organizing the extensive amount of information gathered during the audit of laboratory, field monitoring, and support functions within the agency. The audits will have the same reporting/corrective action requirements as the system audit.

Y.20.1.5 DATA QUALITY ASSESSMENT

A data quality assessment (DQA) is the statistical analysis of environmental data to determine whether the quality of data is adequate to support the decisions which are based on the DQOs. Data are appropriate if the level of uncertainty in a decision based on the data is acceptable.

ARB's PTSD Air Quality Data Review Section has the responsibility to assess the data quality and the suitability of the monitoring network. These functions are done on an annual basis as required under 40 CFR Part 58. Data are processed through data screening programs to determine if they are suitable for use in attainment/nonattainment decisions. Data flagged during this procedure are subject to further evaluation using statistical techniques to determine possible causes of anomalies. Results of these analyses are forwarded to data collection staff for confirmation of validity or nonvalidity of data. If the data are shown to be invalid, Air Quality Data Review Section staff will remove the data from all relevant databases. All changes to the data are to be documented in air quality data action reports.

Measurement uncertainty will be estimated for both automated and manual methods. Terminology associated with measurement uncertainty are found within 40 CFR Part 58, Appendix A and includes: (a) Precision - a measurement of mutual agreement among individual measurements of the same property, usually under prescribed similar conditions, expressed generally in terms of the standard deviation; (b) Accuracy - the degree of agreement between an observed value and an accepted reference value, accuracy includes a combination of random error (precision) and systematic error (bias) components which are due to sampling and analytical operations; (c) Bias - the systematic or persistent distortion of a measurement process which causes errors in one direction. The individual results of these tests for each method or analyzer shall be reported to U.S. EPA.

Estimates of the data quality will be calculated on the basis of single monitors and aggregated to all monitors.

Y.20.2 DOCUMENTATION OF ASSESSMENTS

Table Y.20.0.1 summarizes each of the assessments discussed above.

Table Y.20.0.1
Assessment Summary

Assessment Activity	**Frequency**	**Personnel Responsible**	**Schedule**	**Reporting/Resolution**
MSR	AS NEEDED	MLD AND PTSD	ON-GOING	MLD AND PTSD
Network Reviews App D App E	 1/ year 1/3 years	 PTSD PTSD	 1/1/2000 1/1/2000	 PTSD to MLD
System Audits	to be determined	Quality Assurance Section	1999	MLD Quality Assurance Section to labs
Field and Laboratory Performance Audits	1/ year	Quality Assurance Section	on-going	MLD Quality Assurance Section to air monitoring districts and labs
Data Quality Assessment	1/year	ARB PTSD	1/1/2000	PTSD to U.S. EPA Region IX

Y.21.0 ELEMENT 21 - REPORTS TO MANAGEMENT

This Element describes the quality-related reports and communications to management necessary to support SLAMS/NAMS PM2.5 network operations and the associated data acquisition, validation, assessment, and reporting. Unless otherwise indicated, data pertaining to PM2.5 will be included in reports containing monitoring data for other pollutants.

Important benefits of regular QA reports to management include the opportunity to alert the management of data quality problems, to propose viable solutions to problems, and to procure necessary additional resources. Quality assessment, including the evaluation of the technical systems, the measurement of performance, and the assessment of data, is conducted to ensure that measurement results meet program objectives and that necessary corrective actions are taken early, when they will be most effective. This is particularly important in the new PM2.5 network, as new equipment and procedures are being implemented.

Effective communication among all personnel is an integral part of a quality system. Regular, planned quality reporting provides a means for tracking the following:

- adherence to scheduled delivery of data and reports
- documentation of deviations from approved QA and test plans, and the impact of these deviations on data quality
- analysis of the potential uncertainties in decisions based on the data

Y.21.1 FREQUENCY, CONTENT, AND DISTRIBUTION OF REPORTS

Required reports to management for PM2.5 monitoring and the SLAMS program in general are discussed in various Elements of 40 CFR Parts 50, 53, and 58. Details for PM2.5 monitoring in California can be found in the “1998 California Particulate Matter Monitoring Network Description ” which was submitted by ARB’s PTSD to U.S. EPA Region IX in June 1998. Guidance for management report format and content are provided in guidance developed by U.S. EPA's Quality Assurance Division (QAD) and the Office of Air Quality Planning and Standards (OAQPS). These reports are described in the following subelements.

Y.21.1.1 <u>NETWORK REVIEWS</u>

As required by 40 CFR Part 58 Appendix A, Section 4(a), revised July 18, 1997, the ARB’s PTSD Air Quality Data Review Section has provided a list of all monitoring sites and their AIRS site identification codes and submits the list to the U.S. EPA Region IX Office, with a copy to the Aerometric Information Retrieval System (AIRS)-Air Quality Subsystem (AQS). The AIRS-AQS is U.S. EPA's computerized system for storing and reporting of information relating to ambient air quality data. Whenever there is a change in this list of monitoring sites in a reporting organization, ARB's PTSD Air Quality Data Review Section will report this change to the U.S. EPA Region IX Office, to AIRS-AQS, and to ARB's MLD Quality Assurance Section.

Y.21.1.2 QUARTERLY REPORTS

Each quarter, ARB's MLD will report to AIRS-AQS the results of all precision and accuracy tests it has carried out during the quarter. The quarterly reports will be submitted, consistent with the data reporting requirements specified for air quality data as set forth in 40 CFR Parts 58.26, 58.35, and 40 CFR Part 58, Appendix A, Section 4.

The data reporting requirements of 40 CFR Part 58.35 apply to those stations designated SLAMS or NAMS. Required accuracy and precision data are to be reported on the same schedule as quarterly monitoring data submittals. The required reporting periods and due dates are listed in Table Y.21.0.1.

Table Y.21.0.1
Quarterly Reporting Schedule

Reporting Period	**Due on or Before**
January 1-March 31	June 30
April 1-June 30	September 30
July 1-September 30	December 31
October 1-December 31	March 31 (following year)

Air quality data submitted for each reporting period will be edited, validated, and entered into the AIRS-AQS using the procedures described in the *AIRS Users Guide, Volume II, Air Quality Data Coding.* The ARB's ELB Information Manager will be responsible for preparing the data reports, which will be reviewed by the Inorganics Laboratory Manager and ELB Chief before they are transmitted to U.S. EPA.

Y.21.1.3 SYSTEM AUDIT REPORTS

The ARB performs System Audits of the monitoring system (Element 20) . These reports are issued by the ARB MLD Quality Assurance Section Manager and are reviewed by the Quality Management and Operations Support Branch Chief and the MLD Chief. These reports will be filed (see Table Y.9.0.1) and made available to the U.S. EPA..

External system audits are conducted at least every three years by the U.S. EPA Regional Office as required by 40 CFR Part 58, Appendix A, Section 2.5. Further instructions are available from either the U.S. EPA Regional QA Coordinator or the System Audit QA Coordinator, Office of Air Quality Planning and Standards, Emissions Monitoring and Analysis Division (MD-14), United States Environmental Protection Agency, Research Research Triangle Park, NC 27711.

Y.21.1.4 AIR QUALITY DATA ACTION REQUEST

An Air Quality Data Action (AQDA) request is issued whenever a problem is found such as an operational problem, or a failure to comply with procedures, which could have an effect on data quality. The AQDA request is one of the most important ongoing reports to management because it documents primary QA activities and provides valuable records of QA activities that can be used in preparing other summary reports.

The AQDA request procedure is designed as a closed-loop system. The AQDA request form identifies the originator, who reported and identified the problem, states the problem, and may suggest a solution. The form also indicates the name of the person(s) who is assigned to correct the problem. The assignment of personnel to address the problem and the schedule for completion will be filled in by the appropriate supervisor. The AQDA request procedure closes the loop by requiring that the recipient state on the form how the problem was resolved and what disposition to take with the data (accept, correct, invalidate). Copies of the AQDA request will be distributed twice: first, when the problem has been identified and the action has been scheduled; and second, when the correction has been completed. The originator, district staff (if appropriate), the field or laboratory section managers, branch chiefs, and the QA Section Manager will be included in both distributions.

Y.21.1.5 CONTROL CHARTS WITH SUMMARY

Control charts for laboratory instruments are updated after every new calibration or standardization as defined in the relevant SOP. Analysts are responsible for reviewing each control chart immediately after it is updated and for taking corrective actions whenever an out-of-control condition is observed. Control charts are to be reviewed at least quarterly by the laboratory supervisor. The supervisors will provide quarterly summary information to the QA Section Manager. Control charts are also subject to inspection during audits, and laboratory personnel are responsible for maintaining a readily-accessible file of control charts for each instrument.

Y.21.2 RESPONSIBLE ORGANIZATIONS

This element outlines the responsibilities of individuals within the monitoring organization for preparing quality reports, evaluating their impact, and implementing follow-up actions.

Changes made in one area or procedure may affect another part of the project. Only by defining clear-cut lines of communication and responsibility can all the affected elements of the monitoring network remain current with such changes. The documentation for all changes will be maintained and included in the reports to management. The following paragraphs describe key personnel involved with QA reporting.

Executive Officer of the ARB

The ultimate responsibility for the quality of the data and the technical operation of the fine particle monitoring network rests with the ARB Executive Officer. The Executive Officer's responsibilities with respect to air quality reporting are delegated to the MLD Chief and PTSD Chief. These responsibilities include defining and implementing the document management and quality assurance systems for the PM2.5 monitoring network.

Monitoring and Laboratory Division Chief

The Monitoring and Laboratory Division Chief is ultimately responsible for the data collected from all PM2.5 monitors in the ARB's monitoring network. He delegates responsibility for the collection, validation, and submission of the data collected from all PM2.5 monitors to the branch chiefs. He maintains responsibility for the submittal of all relevant reports.

Air Quality Surveillance Branch Chief

The Air Quality Surveillance Branch Chief maintains responsibility for the proper operation of the PM2.5 monitors and the data collection through the ARB's Air Quality Data Acquisition System (AQDAS) II. He submits all relevant reports to the MLD chief.

Air Monitoring Section Managers

The Air Monitoring Section Managers are directly responsible for the operation, maintenance, and repair of any PM2.5 monitors in their designated areas of monitoring. They submit all relevant reports to the Air Quality Surveillance Branch Chief.

Special Purpose Monitoring Section Manager

The Special Purpose Monitoring Manager is primarily responsible for the AQDAS II network system. He is directly responsible for the operation, maintenance, and repair of any PM2.5 monitors in his designated area of monitoring. He also maintains the responsibility to supply a parts warehouse for PM2.5 monitors.

Field Technicians

Field technicians are not normally responsible for authoring reports to management. However, they participate in the process by identifying the need for AQDAs and maintaining other quality-related information used to prepare QA reports.

Quality Management Chief

The Quality Management Branch Chief conducts and reviews quality assurance, quality assessment, and quality control activities for programs undertaken within MLD and the local districts to ensure ambient air quality data meet or exceed the data quality objectives of the end user.

Program Evaluation and Standards Section Manager

The Program Evaluation and Standards Section Manager is responsible for evaluating the quality assurance and quality control programs to ensure the highest quality data that is feasible, assessing the acceptability of the air quality data prior to its use in the regulatory process, developing and implementing tighter quality control measures at the point of data generation, purchasing NIST standards, and certifying gases and flow standards used in the field and generating appropriate reports.

Quality Assurance Section Manager

The Quality Assurance Section Manager is responsible for the precision and accuracy of all data generated and collected by the State, local, and private air monitoring agencies in the California air monitoring network. This position serves as one of the many aspects in assuring that the data are in compliance with the criteria set by Federal and State Clean Air Acts. These responsibilities are carried out by conducting field and laboratory performance and system audits, issuing Air Quality Data Action requests on instruments that fail, evaluating air monitoring sites, preparing the Quality Assurance Procedures manual, and issuing reports on audit results.

Northern Laboratory Branch Chief

The Northern Laboratory Branch Chief is responsible for identifying problems and notifying the Quality Assurance Section of these problems. The Quality Assurance Section reviews the problems, takes appropriate corrective action and issues AQDAs as necessary. The Engineering and Laboratory Branch Chief is also responsible for assuring that corrections to identified problems are effective and that analysts and site operators under their supervision maintain their documentation files as defined in the network design. Supervisors are responsible for disseminating information appearing in audit reports and other quality-related documents to operations personnel.

Inorganics Laboratory Section Manager

The Inorganics Laboratory Section Manager is responsible for identifying problems and notifying the Quality Assurance Section of these problems. The Quality Assurance Section reviews the problems, takes appropriate corrective action and issues AQDAs as necessary. The Laboratory Manager is also responsible for reviewing laboratory QC data such as control charts and for assuring that repairs and preventive maintenance are completed and that the maintenance is effective. He is also responsible for assuring that analysts under his supervision maintain their documentation files as defined in the relevant SOPs. The Laboratory Manager will assist the Section's staff in preparing QC reports and summaries summaries and is responsible for disseminating information appearing in audit reports and other quality-related documents to operations personnel. The Laboratory Manager also ensures access to data for timely reporting and interpretation and timely delivery of required data to AIRS.

Laboratory Analysts

Individual analysts are responsible for authoring appropriate sections of quarterly QC reports to management. They generate control charts, identify the need for AQDAs, and maintain other quality-related information used to prepare QA and QC reports.

Planning and Technical Support Division Chief

The Planning and Technical Support Division Chief manages the Planning and Technical Support Division and its staff to provide a sound technical and scientific basis for the State's Air Resources Management Program by providing reliable data and with advanced tools to interpret those data to support the establishment of cost-effective regulatory programs.

Air Quality Data Branch Chief

The Air Quality Data Branch Chief is responsible for compiling and publishing California's Ambient Air Quality Data; maintaining a computerized database containing the data and developing systems and processes for distributing these data in electronic form; identifying areas attaining and not attaining the State Ambient Air Quality Standards; evaluating air quality trends and developing tools for determining and presenting these trends; and analyzing and interpreting air quality data in the context of meteorological and emission data to explain the causes and mechanisms responsible for the State's air quality problems.

Air Quality Data Review Section Manager

The Air Quality Data Review Section Manager carefully manages, archives, and distributes the ambient Aerometric data collected on behalf of the State of California's air quality management programs. Specific activities include resolving discrepancies in data, providing for the orderly and efficient transfer of data from data suppliers to the database, and distributing the data to meet customer needs. Further specific duties include the development and implementation of enhancements to the data management systems and to the forms of data distribution and access used to perform the above, and the evaluation of siting issues, including annual network reviews for PM2.5 and other parameters.

Y.22.0 ELEMENT 22 - DATA REVIEW, VALIDATION AND VERIFICATION REQUIREMENTS

This element describes how the California ARB will verify and validate the data collection operations associated with the PM2.5 ambient air monitoring network. Verification can be defined as confirmation by examination and provision of objective evidence that specified requirements have been fulfilled. Validation can be defined as confirmation by examination and provision of objective evidence that the particular requirements for a specific intended use are fulfilled. Although there are a number of objectives of ambient air data, the major objective for the ARB PM2.5 network is for comparison to the NAAQS standard and therefore, this will be identified as the intended use. This element will describe the verification and validation activities that occur at a number of the important data collection phases. Earlier elements of this QAPP describe in detail how the activities in these data collection phases will be implemented to meet the data quality objectives of the program. Review and approval of this QAPP by the ARB and U.S. EPA Region IX provide initial agreement that the processes described in the QAPP, if implemented, will provide data of adequate quality. In order to verify and validate the phases of the data collection operation, the ARB will use various qualitative assessments (e.g., system audits, network reviews) to verify that the QAPP is being followed, and will rely on the various quality control samples, inserted at various phases of the data collection operation, to validate that the data will meet the DQOs described in Element 7.

Y.22.1 SAMPLING DESIGN

The "1998 California Particulate Matter Monitoring Network Description", which was submitted by ARB's PTSD to U.S. EPA Region IX in June of 1998, describes the sampling design for the PM2.5 network established by the ARB. It covers the number of sites required, their location, and the frequency of data collection. The objective of the sampling design is to represent the population of interest at adequate levels of spatial and temporal resolution. Most of these requirements have been described in the Code of Federal Regulations. However, it is the responsibility of the ARB to ensure that the intent of the regulations are properly administered and carried out.

Y.22.1.1 SAMPLING DESIGN VERIFICATION

Verification of the sampling design will occur through three processes:

Network Design Plan Confirmation - The Network Design Plan that discusses the initial deployment of the network must be submitted, reviewed and approved by U.S. EPA Region IX prior to implementation. This process verifies the initial sampling design.

Internal Network Reviews - Once a year, the ARB's PTSD Air Quality Data Review Section will perform a network review to determine whether the network objectives, as described in the Network Design Plan, are still being met, and that the sites are meeting the CFR siting criteria (see Element 20).

External Network Reviews - Every three years the U.S. EPA Region IX Office will conduct a network review to determine whether the network objectives, as described in the Network Design Plan, are still being met, and that the sites are meeting the CFR siting criteria.

Y.22.1.2 SAMPLING DESIGN VALIDATION

The ambient air data derived from the sites will be used to validate the sampling design. This information will be included in network review documentation and appropriately communicated to the U.S. EPA Region IX Office. In addition, the processes described in Element 10 will be used to confirm the network design.

Y.22.2 SAMPLE COLLECTION PROCEDURES

Y.22.2.1 SAMPLE COLLECTION VERIFICATION

Sample collection procedures are described in detail in Element 11 and are developed to ensure proper sampling and to maintain sample integrity. The following processes will be used to verify the sampling collection activities:

System Audits - will be required as described in Element 20

System audits will be used to verify that the sample collection activity is being performed as described in this QAPP and the SOPs. Deviations from the sample collection activity will be noted in audit finding forms and corrected using the procedures described in Element 20.

Y.22.2.2 SAMPLE COLLECTION VALIDATION

The sample collection activity is just one phase of the measurement process. The use of QC samples that have been placed throughout the measurement process can help validate the activities occurring at each phase. The review of QC data, such as the collocated sampling data, field blanks, the FRM performance evaluation, and the sampling equipment verification checks that are described in Elements 14 and 16 can be used to validate the data collection activities. Any data that indicates unacceptable levels of bias or precision or a tendency (trend on a control chart) will be flagged and investigated. This investigation could lead to a discovery of inappropriate sampling activities.

Y.22.3 SAMPLE HANDLING

Elements 11, 12, and 17 detail the requirements for sample handling, including the types of sample containers and the preservation methods used to ensure that they are appropriate to the nature of the sample and the type of data generated from the sample. Due to the size of the filters and the nature of the collected particles, sample handling is one of the phases where inappropriate techniques can have a significant effect on sample integrity and data quality.

Y.22.3.1 VERIFICATION OF SAMPLE HANDLING

As mentioned above, system audits will be performed to ensure the specifications mentioned in the QAPP are being followed. The audits will include checks on the identity of the sample (e.g., proper labeling and chain-of-custody records), packaging in the field, and proper storage conditions (e.g., chain-of-custody and storage records) to ensure that the sample continues to be representative of its native environment as it moves through the data collection operation.

Y.22.3.2 VALIDATION OF SAMPLE HANDLING

Similar to the validation of sampling activities, the review of data from collocated sampling, field blanks, and the FRM performance evaluations, that are described in Elements 14 and 16, can be used to validate the sample handling activities. Acceptable precision and bias in these samples would lead one to believe that the sample handling activities are adequate. Any data that indicates unacceptable levels of bias or precision or a tendency (trend on a control chart) will be flagged and investigated. This investigation could lead to a discovery of inappropriate sample handling activities that require corrective action.

Y.22.4 ANALYTICAL PROCEDURES

Element 13 details the requirements for the analytical methods, which include the pre-sampling weighing activities that give each sample a unique identification, an initial weight, and prepares the sample for the field, and the post-sampling weighing activities, which provide the mass net weight and the final concentration calculations. The methods include acceptance criteria (Elements 13 and 14) for important components of the procedures, along with suitable codes for characterizing each sample's deviation from the procedure.

Y.22.4.1 VERIFICATION OF ANALYTICAL PROCEDURES

As mentioned above, system audits will be performed to ensure the analytical method specifications mentioned in the QAPP are being followed. The audits will include checks on the identity of the sample. Deviations from the analytical procedures will be noted in audit finding forms and corrected using the procedures described in Element 20.

Y.22.4.2 VALIDATION OF ANALYTICAL PROCEDURES

Similar to the validation of sampling activities, the review of data from lab blanks, calibration checks, laboratory duplicates, and other laboratory QC that are described in Elements 14 and 16 can be used to validate the analytical procedures. Acceptable precision and bias in these samples would lead one to believe that the analytical procedures are adequate. Any data that indicates unacceptable levels of bias or precision or a tendency (trend on a control chart) will be flagged and investigated as described in Element 14. This investigation could lead to a discovery of inappropriate analytical procedures, requiring corrective action.

Y.22.5 QUALITY CONTROL

Elements 14 and 16 of this QAPP specify the QC checks that are to be performed during sample collection, handling, and analysis. These include analyses of check standards, blanks, spikes, and replicates, which provide indications of the quality of data being produced by specified components of the measurement process. For each specified QC check, the procedure, acceptance criteria, and corrective action are specified.

Y.22.5.1 VERIFICATION OF QUALITY CONTROL PROCEDURES

As mentioned above, system audits will be performed to ensure the quality control method specifications mentioned in the QAPP are being followed.

Y.22.5.2 VALIDATION OF QUALITY CONTROL PROCEDURES

Validation activities of many of the other data collection phases mentioned in this subelement use the quality control data to validate the proper and adequate implementation of that phase. Therefore, validation of QC procedures will require a review of the documentation of the corrective actions that were taken when QC samples failed to meet the acceptance criteria, and the potential effect of the corrective actions on the validity of the routine data. Element 14 describes the techniques used to document QC review/corrective action activities.

Y.22.6 CALIBRATION

Element 16, as well as the field (Element 11) and the analytical elements (Element 13) detail the calibration activities and requirements for the critical pieces of equipment for the PM2.5 network.

Y.22.6.1 VERIFICATION OF CALIBRATION PROCEDURES

As mentioned above, system audits will be performed to ensure the calibration specifications and corrective actions mentioned in the QAPP are being followed. Deviations from the calibration procedures will be noted in audit finding forms and corrected using the procedures described in Element 20.

Y.22.6.2 VALIDATION OF CALIBRATION PROCEDURES

Similar to the validation of sampling activities, the review of calibration data that are described in Elements 14 and 16 can be used to validate calibration procedures. Calibration data within the acceptance requirements would lead one to believe that the sample collection measurement devices are operating properly. Any data that indicates unacceptable levels of bias or precision or a tendency (trend on a control chart) will be flagged and investigated as described in Elements 14 or 16. This investigation could lead to a discovery of inappropriate calibration procedures or equipment problems requiring corrective action as detailed in the element. Validation would include the review of the documentation to ensure corrective action was taken as prescribed in the QAPP.

Y.22.7 DATA REDUCTION AND PROCESSING

Y.22.7.1 VERIFICATION OF DATA REDUCTION AND PROCESSING PROCEDURES

As mentioned above, system audits will be performed to ensure the data reduction and processing activities mentioned in the QAPP are being followed.

Y.22.7.2 VALIDATION OF DATA REDUCTION AND PROCESSING PROCEDURES

As part of the audits of data quality, discussed in Element 20, a number of sample IDs chosen at random will be identified. All raw data files, including the following, will be selected:

- Presampling weighing activity
- Presampling activities and environment
- Sampling activity and sampler download data
- Sampler calibration in effect during sampling period
- Postsampling handling, storage, and transport to lab
- Postsampling storage and weighing by lab
- Corrective action procedures
- Data reduction and entry

This raw data will be reviewed and final concentrations will be calculated by hand to determine if the final vales submitted to AIRS compare to the hand calculations. The data will also be reviewed to ensure that associated flags or any other data qualifiers have been appropriately associated with the data and that appropriate corrective actions were taken.

THE STATE OF CALIFORNIA

AIR RESOURCES BOARD

AIR MONITORING QUALITY ASSURANCE

VOLUME V

AUDIT PROCEDURES MANUAL

SECTION Y.25.0
APPENDIX A

GLOSSARY

MONITORING & LABORATORY DIVISION

JULY 2001

GLOSSARY OF QUALITY ASSURANCE AND RELATED TERMS

Acceptance criteria — Specified limits placed on characteristics of an item, process, or service defined in requirements documents. (ASQC Definitions)

Accuracy — A measure of the closeness of an individual measurement or the average of a number of measurements to the true value.

Assessment — The evaluation process used to measure the performance or effectiveness of a system and its elements. As used here, assessment is an all-inclusive term used to denote any of the following: audit, performance evaluation (PE), management systems review (MSR), peer review, inspection, or surveillance.

Audit (quality) — A systematic and independent examination to determine whether quality activities and related results comply with planned operations and whether these operations are implemented effectively and are suitable to achieve objectives.

Audit of Data Quality (ADQ) — A qualitative and quantitative evaluation of the documentation and procedures associated with environmental measurements to verify that the resulting data are of acceptable quality.

Authenticate — The act of establishing an item as genuine, valid, or authoritative.

Bias — The systematic or persistent distortion of a measurement process, which causes errors in one direction (i.e., the expected sample measurement is different from the sample's true value).

Blank — A sample subjected to the usual analytical or measurement process to establish a zero baseline or background value. Sometimes used to adjust or correct routine analytical results. A sample that is intended to contain none of the analytes of interest. A blank is used to detect contamination during sample handling preparation and/or analysis.

Calibration — A comparison of a measurement standard, instrument, or item with a standard or instrument of higher accuracy to detect and quantify inaccuracies and to report or eliminate those inaccuracies by adjustments.

Calibration drift — The deviation in instrument response from a reference value over a period of time before recalibration.

Certification — The process of testing and evaluation against specifications designed to document, verify, and recognize the competence of a person, organization, or other entity to perform a function or service, usually for a specified time.

Chain of custody — An unbroken trail of accountability that ensures the physical security of samples, data, and records.

Check standard — A standard prepared independently of the calibration standards and analyzed exactly like the samples. Check standard results are used to estimate analytical precision and to indicate the presence of bias due to the calibration of the analytical system.

Collocated samples — Two or more portions collected at the same point in time and space so as to be considered identical. These samples are also known as field replicates and should be identified as such.

Comparability — A measure of the confidence with which one data set or method can be compared to another.

Completeness — A measure of the amount of valid data obtained from a measurement system compared to the amount that was expected to be obtained under correct, normal conditions.

Computer program — A sequence of instructions suitable for processing by a computer. Processing may include the use of an assembler, a compiler, an interpreter, or a translator to prepare the program for execution. A computer program may be stored on magnetic media and referred to as "software," or it may be stored permanently on computer chips, referred to as "firmware." Computer programs covered in a QAPP are those used for audit results, design analysis, data acquisition, data reduction, data storage (databases), operation or control, and database or document control registers when used as the controlled source of quality information.

Confidence Interval — The numerical interval constructed around a point estimate of a population parameter, combined with a probability statement (the confidence coefficient) linking it to the population's true parameter value. If the same confidence interval construction technique and assumptions are used to calculate future intervals, they will include the unknown population parameter with the same specified probability.

Conformance — An affirmative indication or judgment that a product or service has met the requirements of the relevant specification, contract, or regulation; also, the state of meeting the requirements.

Consensus standard — A standard established by a group representing a cross section of particular government agencies, industry or trade, or a part thereof.

Contractor — Any organization or individual contracting to furnish services or items or to perform work.

Corrective action — Any measures taken to rectify conditions adverse to quality and, where possible, to preclude their recurrence.

Correlation coefficient — A number between -1 and 1 that indicates the degree of linearity between two variables or sets of numbers. The closer to -1 or +1, the stronger the linear relationship between the two (i.e., the better the correlation). Values close to zero suggest no correlation between the two variables.

Data of known quality — Data that have the qualitative and quantitative components associated with their derivation documented appropriately for their intended use, and when such documentation is verifiable and defensible.

Data Quality Assessment (DQA) — The scientific and statistical evaluation of data to determine if data obtained from environmental operations are of the right type, quality, and quantity to support their intended use. The five steps of the DQA Process include: 1) reviewing the DQOs and sampling design, 2) conducting a preliminary data review, 3) selecting the statistical test, 4) verifying the assumptions of the statistical test, and 5) drawing conclusions from the data.

Data Quality Indicators (DQIs) — The quantitative statistics and qualitative descriptors that are used to interpret the degree of acceptability or utility of data to the user. The principal data quality indicators are bias, precision, accuracy, comparability, completeness, representativeness.

Data Quality Objectives (DQOs) — The qualitative and quantitative statements derived from the DQO Process that clarify a study's technical and quality objectives, define the appropriate type of data, and specify tolerable levels of potential decision errors that will be used as the basis for establishing the quality and quantity of data needed to support decisions.

Data Quality Objectives (DQO) Process — A systematic strategic planning tool based on the scientific method that identifies and defines the type, quality, and quantity of data needed to satisfy a specified use. The key elements of the DQO process include:

- state the problem,
- identify the decision,
- identify the inputs to the decision,
- define the boundaries of the study,
- develop a decision rule,
- specify tolerable limits on decision errors, and
- optimize the design for obtaining data

DQOs are the qualitative and quantitative outputs from the DQO Process.

Data reduction — The process of transforming the number of data items by arithmetic or statistical calculations, standard curves, and concentration factors, and collating them into a more useful form. Data reduction is irreversible and generally results in a reduced data set and an associated loss of detail.

Data usability — The process of ensuring or determining whether the quality of the data produced meets the intended use of the data.

Deficiency — An unauthorized deviation from acceptable procedures or practices, or a defect in an item.

Design — The specifications, drawings, design criteria, and performance requirements. Also, the result of deliberate planning, analysis, mathematical manipulations, and design processes.

Detection Limit (DL) — A measure of the capability of an analytical method to distinguish samples that do not contain a specific analyte from samples that contain low concentrations of the analyte; the lowest concentration or amount of the target analyte that can be determined to be different from zero by a single measurement at a stated level of probability. DLs are analyte- and matrix-specific and may be laboratory-dependent.

Distribution — 1) The appointment of an environmental contaminant at a point over time, over an area, or within a volume; 2) a probability function (density function, mass function, or distribution function) used to describe a set of observations (statistical sample) or a population from which the observations are generated.

Document — Any written or pictorial information describing, defining, specifying, reporting, or certifying activities, requirements, procedures, or results.

Document control — The policies and procedures used by an organization to ensure that its documents and their revisions are proposed, reviewed, approved for release, inventoried, distributed, archived, stored, and retrieved in accordance with the organization's requirements.

Duplicate samples — Two samples taken from and representative of the same population and carried through all steps of the sampling and analytical procedures in an identical manner. Duplicate samples are used to assess variance of the total method, including sampling and analysis. See also *collocated sample*.

Environmental conditions — The description of a physical medium (e.g., air, water, soil, sediment) or a biological system expressed in terms of its physical, chemical, radiological, or biological characteristics.

Environmental data — Any parameters or pieces of information collected or produced from measurements, analyses, or models of environmental processes, conditions, and effects of pollutants on human health and the ecology, including results from laboratory analyses or from experimental systems representing such processes and conditions.

Environmental monitoring — The process of measuring or collecting environmental data.

Environmental processes — Any manufactured or natural processes that produce discharges to, or that impact, the ambient environment.

Environmental programs — An all-inclusive term pertaining to any work or activities involving the environment, including but not limited to: characterization of environmental processes and conditions; environmental monitoring; environmental research and development; the design, construction, and operation of environmental technologies; and laboratory operations on environmental samples.

Environmental technology — An all-inclusive term used to describe pollution control devices and systems, waste treatment processes and storage facilities, and site remediation technologies and their components that may be utilized to remove pollutants or contaminants from, or to prevent them from entering, the environment. Examples include wet scrubbers (air), soil washing (soil), granulated activated carbon unit (water), and filtration (air, water). Usually, this term applies to hardware-based systems; however, it can also apply to methods or techniques used for pollution prevention, pollutant reduction, or containment of contamination to prevent further movement of the contaminants, such as capping, solidification or vitrification, and biological treatment.

Estimate — A characteristic from the sample from which inferences on parameters can be made.

Field blank — A blank used to provide information about contaminants that may be introduced during sample collection, storage, and transport. A clean sample, carried to the sampling site, exposed to sampling conditions, returned to the laboratory, and treated as an environmental sample.

Financial assistance — The process by which funds are provided by one organization (usually governmental) to another organization for the purpose of performing work or furnishing services or items. Financial assistance mechanisms include grants, cooperative agreements, and governmental interagency agreements.

Finding — An assessment conclusion that identifies a condition having a significant effect on an item or activity. An assessment finding may be positive or negative, and is normally accompanied by specific examples of the observed condition.

Goodness-of-fit test — The application of the chi square distribution in comparing the frequency distribution of a statistic observed in a sample with the expected frequency distribution based on some theoretical model.

Guidance — A suggested practice that is not mandatory, intended as an aid or example in complying with a standard or requirement.

Guideline — A suggested practice that is not mandatory in programs intended to comply with a standard.

Holding time — The period of time a sample may be stored prior to its required analysis.

Identification error — The misidentification of an analyte. In this error type, the contaminant of concern is unidentified and the measured concentration is incorrectly assigned to another contaminant.

Independent assessment — An assessment performed by a qualified individual, group, or organization that is not a part of the organization directly performing and accountable for the work being assessed.

Inspection — The examination or measurement of an item or activity to verify conformance to specific requirements.

Internal standard — A standard added to a test portion of a sample in a known amount and carried through the entire determination procedure as a reference for calibrating and controlling the precision and bias of the applied analytical method.

Laboratory split samples — Two or more representative portions taken from the same sample and analyzed by different laboratories to estimate the interlaboratory precision or variability and the data comparability.

Limit of quantitation — The minimum concentration of an analyte or category of analytes in a specific matrix that can be identified and quantified above the method detection limit and within specified limits of precision and bias during routine analytical operating conditions.

Management — Those individuals directly responsible and accountable for planning, implementing, and assessing work.

Management system — A structured, nontechnical system describing the policies, objectives, principles, organizational authority, responsibilities, accountability, and implementation plan of an organization for conducting work and producing items and services.

Management Systems Review (MSR) — The qualitative assessment of a data collection operation and/or organization(s) to establish whether the prevailing quality management structure, policies, practices, and procedures are adequate for ensuring that the type and quality of data needed are obtained.

Matrix spike — A sample prepared by adding a known mass of a target analyte to a specified amount of matrix sample for which an independent estimate of the target analyte concentration is available. Spiked samples are used, for example, to determine the effect of the matrix on a method's recovery efficiency.

May — When used in a sentence, a term denoting permission but not a necessity.

Mean (arithmetic) — The sum of all the values of a set of measurements divided by the number of values in the set; a measure of central tendency.

Mean squared error — A statistical term for variance added to the square of the bias.

Measurement and Testing Equipment (M&TE) — Tools, gauges, instruments, sampling devices, or systems used to calibrate, measure, test, or inspect in order to control or acquire data to verify conformance to specified requirements.

Memory effects error — The effect that a relatively high concentration sample has on the measurement of a lower concentration sample of the same analyte when the higher concentration sample precedes the lower concentration sample in the same analytical instrument.

Method — A body of procedures and techniques for performing an activity (e.g., sampling, chemical analysis, quantification), systematically presented in the order in which they are to be executed.

Method blank — A blank prepared to represent the sample matrix as closely as possible and analyzed exactly like the calibration standards, samples, and quality control (QC) samples. Results of method blanks provide an estimate of the within-batch variability of the blank response and an indication of bias introduced by the analytical procedure.

Mid-range check — A standard used to establish whether the middle of a measurement method's calibrated range is still within specifications.

Must — When used in a sentence, a term denoting a requirement that has to be met.

Nonconformance — A deficiency in a characteristic, documentation, or procedure that renders the quality of an item or activity unacceptable or indeterminate; nonfulfillment of a specified requirement.

Objective evidence — Any documented statement of fact, other information, or record, either quantitative or qualitative, pertaining to the quality of an item or activity, based on observations, measurements, or tests that can be verified.

Observation — An assessment conclusion that identifies a condition (either positive or negative) that does not represent a significant impact on an item or activity. An observation may identify a condition that has not yet caused a degradation of quality.

Organization — A company, corporation, firm, enterprise, or institution, or part thereof, whether incorporated or not, public or private, that has its own functions and administration.

Organization structure — The responsibilities, authorities, and relationships, arranged in a pattern, through which an organization performs its functions.

Outlier — An extreme observation that is shown to have a low probability of belonging to a specified data population.

Parameter — A quantity, usually unknown, such as a mean or a standard deviation characterizing a population. Commonly misused for "variable," "characteristic," or "property."

Peer review — A documented critical review of work generally beyond the state of the art or characterized by the existence of potential uncertainty. Conducted by qualified individuals (or an organization) who are independent of those who performed the work but collectively equivalent in technical expertise (i.e., peers) to those who performed the original work. Peer reviews are conducted to ensure that activities are technically adequate, competently performed, properly documented, and satisfy established technical and quality requirements. An in-depth assessment of the assumptions, calculations, extrapolations, alternate interpretations, methodology, acceptance criteria, and conclusions pertaining to specific work and of the documentation that supports them. Peer reviews provide an evaluation of a subject where quantitative methods of analysis or measures of success are unavailable or undefined, such as in research and development.

Performance Evaluation (PE) — A type of audit in which the quantitative data generated in a measurement system are obtained independently and compared with routinely obtained data to evaluate the proficiency of an analyst or laboratory.

Pollution prevention — An organized, comprehensive effort to systematically reduce or eliminate pollutants or contaminants prior to their generation or their release or discharge into the environment.

Population — The totality of items or units of material under consideration or study.

Precision — A measure of mutual agreement among individual measurements of the same property, usually under prescribed similar conditions expressed generally in terms of the standard deviation.
Procedure — A specified way to perform an activity.

Process — A set of interrelated resources and activities that transforms inputs into outputs. Examples of processes include analysis, design, data collection, operation, fabrication, and calculation.

Project — An organized set of activities within a program.

Qualified data — Any data that have been modified or adjusted as part of statistical or mathematical evaluation, data validation, or data verification operations.

Qualified services — An indication that suppliers providing services have been evaluated and determined to meet the technical and quality requirements of the client as provided by approved procurement documents and demonstrated by the supplier to the client's satisfaction.

Quality — The totality of features and characteristics of a product or service that bears on its ability to meet the stated or implied needs and expectations of the user.

Quality Assurance (QA) — An integrated system of management activities involving planning, implementation, assessment, reporting, and quality improvement to ensure that a process, item, or service is of the type and quality needed and expected by the client.

Quality Assurance Program Description/Plan — See *quality management plan*.

Quality Assurance Project Plan (QAPP) — A formal document describing in comprehensive detail the necessary quality assurance (QA), quality control (QC), and other technical activities that must be implemented to ensure that the results of the work performed will satisfy the stated performance criteria. The QAPP components are divided into four classes: 1) Project Management, 2) Measurement/Data Acquisition, 3) Assessment/Oversight, and 4) Data Validation and Usability. Guidance and requirements on preparation of QAPPs can be found in EPA QA/R-5 and QA/G-5.

Quality Control (QC) — The overall system of technical activities that measures the attributes and performance of a process, item, or service against defined standards to verify that they meet the stated requirements established by the customer; operational techniques and activities that are used to fulfill requirements for quality. The system of activities and checks used to ensure that measurement systems are maintained within prescribed limits, providing protection against "out of control" conditions and ensuring the results are of acceptable quality.

Quality control (QC) sample — An uncontaminated sample matrix spiked with known amounts of analytes from a source independent of the calibration standards. Generally used to establish intra-laboratory or analyst-specific precision and bias or to assess the performance of all or a portion of the measurement system.

Quality improvement — A management program for improving the quality of operations. Such management programs generally entail a formal mechanism for encouraging worker recommendations with timely management evaluation and feedback or implementation.

Quality management — That aspect of the overall management system of the organization that determines and implements the quality policy. Quality management includes strategic planning, allocation of resources, and other systematic activities (e.g., planning, implementation, and assessment) pertaining to the quality system.

Quality Management Plan (QMP) — A formal document that describes the quality system in terms of the organization's structure, the functional responsibilities of management and staff, the lines of authority, and the required interfaces for those planning, implementing, and assessing all activities conducted.

Quality system — A structured and documented management system describing the policies, objectives, principles, organizational authority, responsibilities, accountability, and implementation plan of an organization for ensuring quality in its work processes, products, and services. The quality system provides the framework for planning, implementing, and assessing work performed by the organization and for carrying out required quality assurance (QA) and quality control (QC).

Readiness review — A systematic, documented review of the readiness for the start-up or continued use of a facility, process, or activity. Readiness reviews are typically conducted before proceeding beyond project milestones and prior to initiation of a major phase of work.

Record (quality) — A document that furnishes objective evidence of the quality of items or activities and that has been verified and authenticated as technically complete and correct. Records may include photographs, drawings, magnetic tape, and other data recording media.

Recovery — The act of determining whether or not the methodology measures all of the analyte contained in a sample.

Repeatability — The degree of agreement between independent test results produced by the same analyst, using the same test method and equipment on random aliquots of the same sample within a short time period.

Reporting limit — The lowest concentration or amount of the target analyte required to be reported from a data collection project. Reporting limits are generally greater than detection limits and are usually not associated with a probability level.

Representativeness — A measure of the degree to which data accurately and precisely represent a characteristic of a population, a parameter variation at a sampling point, a process condition, or an environmental condition.

Reproducibility — The precision, usually expressed as variance, that measures the variability among the results of measurements of the same sample at different laboratories.

Requirement — A formal statement of a need and the expected manner in which it is to be met.

Research (applied) — A process, the objective of which is to gain the knowledge or understanding necessary for determining the means by which a recognized and specific need may be met.

Research (basic) — A process, the objective of which is to gain fuller knowledge or understanding of the fundamental aspects of phenomena and of observable facts without specific applications toward processes or products in mind.

Research development/demonstration — The systematic use of the knowledge and understanding gained from research and directed toward the production of useful materials, devices, systems, or methods, including prototypes and processes.

Round-robin study — A method validation study involving a predetermined number of laboratories or analysts, all analyzing the same sample(s) by the same method. In a round-robin study, all results are compared and used to develop summary statistics such as interlaboratory precision and method bias or recovery efficiency.

Ruggedness study — The carefully ordered testing of an analytical method while making slight variations in test conditions (as might be expected in routine use) to determine how such variations affect test results. If a variation affects the results significantly, the method restrictions are tightened to minimize this variability.

Scientific method — The principles and processes regarded as necessary for scientific investigation, including rules for concept or hypothesis formulation, conduct of experiments, and validation of hypotheses by analysis of observations.

Self-assessment — The assessments of work conducted by individuals, groups, or organizations directly responsible for overseeing and/or performing the work.

Sensitivity — the capability of a method or instrument to discriminate between measurement responses representing different levels of a variable of interest.

Service — The result generated by activities at the interface between the supplier and the customer, and the supplier internal activities to meet customer needs. Such activities in environmental programs include design, inspection, laboratory and/or field analysis, repair, installation, and calibration.

Shall — A term denoting a requirement that is mandatory whenever the criterion for conformance with the specification permits no deviation. This term does not prohibit the use of alternative approaches or methods for implementing the specification so long as the requirement is fulfilled.

Should — A term denoting a guideline or recommendation whenever noncompliance with the specification is permissible.

Significant condition — Any state, status, incident, or situation of an environmental process or condition, or environmental technology in which the work being performed will be adversely affected sufficiently to require corrective action to satisfy quality objectives or specifications and safety requirements.

Software life cycle — The period of time that starts when a software product is conceived and ends when the software product is no longer available for routine use. The software life cycle typically includes a requirement phase, a design phase, an implementation phase, a test phase, an installation and check-out phase, an operation and maintenance phase, and sometimes a retirement phase.

Span check — A standard used to establish that a measurement method is not deviating from its calibrated range.

Specification — A document stating requirements and referring to or including drawings or other relevant documents. Specifications should indicate the means and criteria for determining conformance.

Spike — A substance that is added to an environmental sample to increase the concentration of target analytes by known amounts; used to assess measurement accuracy (spike recovery). Spike duplicates are used to assess measurement precision.

Split samples — Two or more representative portions taken from one sample in the field or in the laboratory and analyzed by different analysts or laboratories. Split samples are quality control (QC) samples that are used to assess analytical variability and comparability.

Standard deviation — A measure of the dispersion or imprecision of a sample or population distribution expressed as the positive square root of the variance and has the same unit of measurement as the mean.

Standard Operating Procedure (SOP) — A written document that details the method for an operation, analysis, or action with thoroughly prescribed techniques and steps and that is officially approved as the method for performing certain routine or repetitive tasks.

Supplier — Any individual or organization furnishing items or services or performing work according to a procurement document or a financial assistance agreement. An all-inclusive term used in place of any of the following: vendor, seller, contractor, subcontractor, fabricator, or consultant.

Surrogate spike or analyte — A pure substance with properties that mimic the analyte of interest. It is unlikely to be found in environmental samples and is added to them to establish that the analytical method has been performed properly.

Surveillance (quality) — Continual or frequent monitoring and verification of the status of an entity and the analysis of records to ensure that specified requirements are being fulfilled.

THE STATE OF CALIFORNIA

AIR RESOURCES BOARD

AIR MONITORING QUALITY ASSURANCE

VOLUME V

AUDIT PROCEDURES MANUAL

SECTION Y.26.0
APPENDIX B

S.O.P MLD 055

STANDARD OPERATING PROCEDURE FOR
MASS ANALYSIS OF FINE PARTICULATE
COLLECTED ON TEFLON FILTERS

MONITORING & LABORATORY DIVISION

JULY 2001

CALIFORNIA AIR RESOURCES BOARD
MONITORING AND LABORATORY DIVISION

S.O.P MLD 055 - DRAFT (10/16/98)

STANDARD OPERATING PROCEDURE FOR MASS ANALYSIS OF FINE PARTICULATE COLLECTED ON TEFLON FILTERS

1.0.0 SCOPE

This document describes the methodology used by the Monitoring and Laboratory (MLD) Inorganics Laboratory staff to analyze the mass of fine particulate matter (PM2.5) samples collected on Teflon filters.

2.0.0 SUMMARY OF METHOD

Individual teflon filters (46.2 mm in diameter) are weighed on an electronic microbalance before and after field sampling. Particulate matter less than 2.5 micrometers in diameter is collected from ambient air over a 24-hour period on one of these filters. The net net difference between pre- and postsampling filter weights is used to calculate the ambient air mass concentration. After postweighing, filters are stored for subsequent analysis.

3.0.0 INTERFERENCES

3.1 The potential effect of body moisture or oils contacting the filters is minimized by using non-serrated forceps to handle the filters at all times. This measure also moderates interference due to static electricity.

3.2 Teflon filters accumulate a surface electrical charge which may affect filter weight. Static electricity is controlled by treating filters on a “Static Master” static charge neutralizer prior to weighing. Placement of filters upon the “Static Master” is required for a minimum of 30 seconds before any filter can be weighed.

3.3 Moisture content can affect filter weight. Filters must be equilibrated for a minimum of 24 hours in a controlled environment prior to pre- and postweighing. During the equilibration period, relative humidity must be maintained at a mean value of 35-40% and air temperature at a mean of 21-23 degrees Celsius.

3.4 Airborne particulates can adversely affect an accurate mass measurement of the filter. Equilibrating filters should not be placed within airflow paths created by air conditioning ductwork, near computer printers or turbulence created by opening and closing doors. Dust contamination can be further minimized by cleaning the lab bench tops and weighing areas daily, installing "sticky" floor mats at the entrance to the balance room, and wearing clean lab coats over regular clothing.

4.0.0 APPARATUS

4.1 Sartorius M3P (or M5P) electronic microbalance with a minimum resolution of 0.001 mg (i.e., 1 microgram) and a precision of $\pm$ 0.001 mg, supplied with a balance pan. The microbalance must be positioned upon a vibration-damping balance support table and should be interfaced with a Laboratory Information Management System (LIMS) database system.

4.2 Calibration weights, utilized as Mass Reference Standards, should be non-corroding, range in weight from 100 mg to 200 mg, and be certified as traceable to National Institute of Standards and Testing (NIST) mass standards. Two sets are needed, one set as a working standard and one set as the primary standard. The weights should be Class 1 category with a tolerance of 0.01mg.

4.3 Radioactive (alpha-particle) Polonium-210 ("StaticMaster") antistatic strips for charge neutralization. At least 6 strips are needed per balance.

4.4 Non-metallic, non-serrated forceps.

4.5 Digital timer/stopwatch.

4.6 Filter: Teflon membrane, 46.2 mm in diameter with a polypropylene support ring.

4.7 Filter support cassettes.

4.8 Filter equilibration racks.

4.9 Honeywell relative humidity/temperature recorder.

4.10 Psychrometer (NIST certified) for calibration of relative humidity readings.

4.11 Precision thermometer (NIST certified) for calibration of temperature readings.

4.12 Light box , 16" x 18".

4.13 Antistatic, nitrate-free, phosphate-free, sulfate-free vinyl gloves.

4.14 Plastic petri-slide filter containers.

4.15 Zip-lock plastic bags, 5"x8".

4.16 Disposable laboratory wipes.

4.17 Filter equilibration cabinets.

4.18 Metal filter-shipping cylinders (supplied with Andersen FRM samplers).

5.0.0 BALANCE CALIBRATION PROCEDURE

5.1 Prior to any filter weighing, the balance must be calibrated. First, check the balance level and adjust as needed. After connecting the balance to a line source, the liquid crystal display should read “stand-by”. Press the on/off key to activate the balance. The balance performs an internal circuitry check, which is complete when “CH2" appears in the liquid crystal display (LCD). The LCD then displays an “L”, indicating that the load weights should be removed (The load weights are used only for weighing objects in excess of 750 or 1500 mg). Press the bottom white key marked with the small white “t” to remove the load weights. The LCD should soon display “0.000" and a stabilization bubble. Open the weighing chamber door to allow equilibration to room temperature. To ensure maximum stability, the microbalance must remain on at all times; the display will register “stand-by” when not in use.

5.2 Internal Calibration: After chamber equilibration (usually one minute), close the cover. Once the stabilization bubble in the LCD (hereafter referred to as the “bubble”) appears above the “mg”, press the “CAL” key. The LCD should soon display “C” followed by “0.000" and the bubble. Press the “CAL” key a second time and the LCD will display a “CC” followed by “0.000" and the bubble. The balance is now ready for an external calibration check. However, should the display read “CE”, an error has occurred and the calibration must be repeated as described above.

5.3 External Calibration Check: Open the chamber door. Place a 100 mg working reference standard calibration weight onto the balance pan with nonmetallic forceps. Close the chamber door and record the date, temperature, and relative humidity in a quality control notebook assigned to the microbalance on which the weighing procedure is being performed. After the LCD displays a weight readout and the bubble, wait for 30-45 seconds, then record the weight readout in the quality control logbook, along with temperature and humidity data and initial. Remove the calibration weight and tare the balance by tapping the red “T” key to re-register a balance zero reading. Repeat this same procedure with a 200 mg calibration weight. The balance is now ready for weighing the filters. If a LIMS database system has been interfaced with the balance, the weight readouts of calibration and filter masses can be transferred into the database with a transmit key on the balance. The quality control logbook must still be maintained. External calibration will be performed daily for each day that filters are pre- and/or postweighed.

6.0.0 FILTER INSPECTION AND EQUILIBRATION

6.1 When the filters initially are brought into the laboratory for preconditioning and preweighing, they should be transferred from their sealed manufacturer's packaging to a filter-handling container, such as a glass or plastic petri dish. The filters should be handled only with non-serrated forceps. Vinyl gloves that are ion-free, powder-free and antistatic may be worn by lab personnel when filters are being prepared for conditioning and weighing. These precautions reduce the risk of body moisture or oils coming into contact with the filters and affecting mass measurements. Before the filter is placed in a container, it has to be inspected for defects. This is done by examining a filter on a "light table" or over a dark surface (lab bench top). A filter must be discarded if any defects are found. Specific defects to look for are the following:

1. **Pinhole--**A small hole appearing (a) as a distinct and obvious bright point of light when examined over a light table or screen, or (b) as a dark spot when viewed over a dark surface.

2. **Separation of ring--**Any separation or lack of seal between the filter and the filter border reinforcing the ring.

3. **Chaff or flashing**--Any extra material on the reinforcing, polyolefin ring or on the heat seal area that would prevent an airtight seal during sampling.

4. **Loose material**--Any extra loose material or dirt particles on the filter.

5. **Discoloration**--Any obvious discoloration that might be evidence of contamination.

6. **Filter nonuniformity--**Any obvious visible nonuniformity in the appearance of the filter when viewed over a light table or black surface that might indicate gradations in porosity or density across the face of the filter.

7. **Other**--A filter with any imperfection not described above, such as irregular surfaces or other results of poor workmanship.

6.2 After inspection, filters must be conditioned within an environmentally controlled room for at least 24 hours prior to performing presampling weighing (preweighing). Mean relative humidity must be held to 35-40 % and the mean temperature must be held to 21-23 degrees Celsius. Every 6 months, the hygrothermograph recorder is recalibrated as a quality control check. The relative humidity recording is checked against a NIST- certified psychrometer and the temperature recording is checked against a NIST-certified thermometer.

6.3 From each new lot of filters received, take a random sample of 3 filters as "lot blanks" and expose each in a separate container within the controlled room environment. Weigh these "lot blanks" every 24 hours (as explained in Sections 7.6 and 7.7). The filters should be conditioned in an open-sided cabinet that will allow air circulation over the filters while reducing the chance that extraneous airborne material inside the conditioning room will settle onto the filters. If the weight change after 24 hours exceeds 15 micrograms, continue conditioning until the 24-hour weight variation is less than 15 micrograms for each of the 3 "lot blanks". This process should take less than a week. Inscribe information concerning the lot number, balance ID number, and dates of "lot blank" weighings on a <u>Lot Blank Filter Conditioning Mass Data Form</u>. Once the "lot blanks" have generated stable mass values, note the time taken from initial exposure of the filters to balance room conditions until achievement of stable mass. This period is designated as the minimum time needed to condition other filters from the same lot before they can be preweighed and used for routine sampling.

6.4 After the minimum conditioning period has been determined, select a number of filters that can be satisfactorily weighed with an acceptable level of precision within the normal working day (20-40 filters should be an adequate number). Condition the selected filters for at least the time required and set aside for preweighing.

7.0.0 <u>PRESAMPLING FILTER WEIGHING</u>

7.1 Record the relative humidity and temperature of the conditioning environment in the quality control logbook for the balance. Ensure that: 1) the temperature and the relative humidity of the Balance Room have remained (and are currently) within the allowable limits (see Section 3.0.0) throughout the previous 24 hours, and that 2) the selected filters have been conditioned for at least the minimum time needed to attain mass stability, as determined from the lot blanks.

7.2 Clean the microbalance's weighing chamber with a fine brush, if necessary. Clean the surfaces near the microbalance with antistatic solution or methyl alcohol-moistened disposable laboratory wipes. Clean the forceps used for handling the mass reference weights and the filters with the moistened wipes prior to each weighing session. Ensure that both forceps are thoroughly dry.

7.3 Perform an internal and external calibration of the microbalance (as described in Section 5.0.0) prior to beginning each daily weighing session. Once the weighing procedure begins; however, you only need to tare (i.e., zero) the microbalance before weighing each consecutive filter.

7.4 Obtain a metal filter-shipping container designated for use with the monitoring site for which filters are to be preweighed, and appropriate filter support cassettes and metal covers. For filters being sent to monitoring sites using single-day (R&P) samplers, use cassettes with a beveled inner edge on the top ring; for filters being sent to monitoring sites using sequential (Andersen) samplers, use cassettes without the beveled top ring.

7.5 Log-on to the LIMS and click on the **PM2.5 BALANCE WEIGHING** icon and then the **PREWEIGHT** icon. At the LIMS prompts, enter the year and quarter in which the filters are to be used, not the quarter they are to be weighed. Hit the return key for the **PREWEIGHT FILTER NUMBER** option, enter the designated filter number, and hit the return key for acceptance. LIMS will bring up the filter number and a blank space for mass data input.

7.6 Take each conditioned filter, using forceps and gripping the filter only by the outer polyolefin support ring, and place the filter (support ring side up) onto a static neutralizer. Allow the filter to remain on the static neutralizer for a minimum of 30 seconds prior to weighing.

7.7 Next, place the filter (using forceps) into the balance chamber and close the cover. Each filter is assigned a **24-Hour Sample Report-Field Data Sheet** (24-Hr Report) that includes the **chain of custody record** and will be used for recording information about the filter sample. At the end of 30 seconds, press the "transmit/print" key on the balance, and LIMS will register the mass in the database and on the monitor. Record this mass as a "preweight" value on the 24-Hr Report Sheet. Date and initial the 24-Hr Report and enter a date on the "Postweigh by" line that is 30 days from the preweighing date.

7.8 After the weight is transmitted, LIMS prompts the analyst to begin weighing the next available filter. If there is a need to re-weigh a filter, however, press the **RE-WEIGH** option and LIMS will clear the previous mass value from the screen. Wait another 30 seconds, then press the "transmit" key. Record the new value.

7.9 After the filter is weighed, it is secured in an appropriate (see Section 7.4) filter support cassette, with the filter's support ring facing up. Fasten the protective metal covers onto the cassette and place it in the metal filter-shipping cylinder used for transfer to the sampling site. The filter cassette must be marked with an identifying number on its side. This number must also be recorded on the 24-Hr Report Sheet as the Cassette ID Number.

7.10 After each filter is weighed, the microbalance is zeroed by pressing the red **TARE** key. The balance is now ready for the next filter.

7.11 After repeating the above steps for 9 individual filters, LIMS prompts a "**field blank**" filter mass weighing. Select any conditioned filter and weigh as described above, but select a filter number preceded by an **FB** and record this number on the 24-Hr Report. Once this weighing has been completed, LIMS prompts a "**check standard**" mass weighing. The microbalance is tared, and either a 100 mg or a 200 mg mass working reference standard is weighed as a QC check.

NOTE: Each working standard will be checked against the corresponding laboratory primary standard weight at least quarterly. If the standards disagree by more than 3 micrograms, the working standards must be checked by a certified outside contractor and replaced if necessary.

7.12 A duplicate filter must be selected from the previous 9 routine sample filters and weighed as a quality control check. LIMS will prompt a **Duplicate** weighing by providing, on screen, the filter number of (usually) the first selected routine sample filter. Weigh the filter, as described above, record the weight on the 24-Hour Report as a duplicate mass, and transmit into LIMS. If the duplicate mass varies more than 15 micrograms from the original mass measurement, tare the microbalance and re-weigh the filter. If the variation in mass remains more than 15 micrograms, flag the filter in question and consult with the laboratory supervisor.

7.13 Affix to each filter's 24-Hr Report sheet a filter bar code label corresponding to the filter ID number, and record the site name. The site operator will add the AIRS site number and other relevant information needed to characterize a specific filter sampled at a specified site. When the preweighed filters are loaded into the sampler, the **chain of custody record** will be signed by the field operator and the date and time recorded.

7.14 Stack together all 24-Hr Reports for filters in one filter-shipping cylinder going to one site, folded so that the site name is readable. Place these in a 5"x8" zip-lock bag and wrap this around the metal shipping cylinder, securing in place with a rubber band. Take this assembly to the Stockroom, to be shipped to the indicated monitoring site.

7.15 During the first preweighing session, and as needed during later weighing sessions (consult with the laboratory supervisor), designate five filters to be used as **lab**

blanks. Assign a unique identification number LBxxxx to each of five filters and record this on the petri-slide label and in the laboratory QC notebook. Weigh as indicated in Sections 7.6 and 7.7, except that weight results will be recorded, along with the date, only in the QC notebook. Initial each weight entry. Replace the filters in their petri-slides and leave open in the cabinet where sample filters are conditioned.

8.0.0 POSTSAMPLING TRACKING, DOCUMENTATION & INSPECTION

8.1 Upon receipt of filter samples from the field, Stockroom personnel will perform the following steps:

1. Receive the shipping/transport container.

2. Remove the metal filter-shipping cylinder and immediately place it in a refrigerator/freezer that is kept at 4 degrees Celsius or lower.

8.2 Balance Room personnel will pick up the filter-shipping cylinders from the Stockroom and move them to a check-in area where they will check the temperature recorders on the cylinders, remove the attached bag of 24-Hr Reports, then place the cylinder either in a lab refrigerator/freezer at 4 degrees Celsius or lower, or take it directly to the Balance Room. On each 24-Hr Report, in the "received by lab" column on the **chain of custody record**, note date, time, and temperature at the time of sample arrival in the lab. Also inspect the condition of the sample container and filter samples, especially for contamination by moisture during shipping. Keep the 24-Hr Reports with the shipping cylinder.

8.3 Balance room personnel will verify acceptance of the filters for postweighing by examining the 24-Hr Report Sheet (which includes the **chain of custody**). If field data are missing or not obtainable from the site operator, or if a sampler malfunction is evident, "flag" the filter on its 24-Hr Report Sheet (and in LIMS during log-in) and continue processing the next filter. A "flagged" filter is archived and stored under refrigeration until further consultation with a lab supervisor determines whether the filter is acceptable or declared invalid.

8.4 When ready to start conditioning of the filters (as determined by temperature during shipping and maximum days allowed until postweighing, and /or weighing room workload) move the shipping cylinder to the Balance Room. If the shipping container arrives to the balance room more than 15 degrees below room temperature, allow it to warm to the temperature in the room before opening to avoid water condensation on a cold filter. Remove each filter cassette from the shipping container and remove its protective metal covers, but keep the filter in its filter support cassette for identification purposes. Use a "light table" to check on the physical appearance of the filter sample area (especially for pinholes). If particulate matter is found on the metal covers after the filter has been removed, record notes on the 24-Hr Report and "flag" the filter. Consult the lab supervisor to determine if the filter should be invalidated.

8.5 Match the filter cassette with the appropriate 24-Hr Report and with a petri-slide labeled with a barcode number identical to the filter ID number. Remove the filter from the support cassette using non-serrated forceps. Antistatic, ion-free vinyl gloves may be worn during filter handling. Inspect the filter for any damage that may have occurred during sampling that was not revealed during the initial inspection. If any damage is found, "flag" the filter and record this on the 24-Hr Report sheet and hold the filter for further consultation by the lab supervisor. If the filter is found to be acceptable for mass analysis, transfer it into the petri-slide and place the cover on loosely.

8.6 After the filters have been inspected and processed as described above, log in each individual filter by transmitting the bar-code number on the Field Data Sheet provided into the LIMS database. Write the LIMS ID number generated from the database onto the 24-Hr Report, the petri-slide label, and in a laboratory logbook. Place each filter (in its petri-slide, with the cover underneath or fitted loosely to allow free circulation of air over the filter) onto a portable filter equilibration rack and place in a well-ventilated cabinet in the balance room. Allow the filters to equilibrate for at least 24 hours. It should be noted that the relative humidity conditions for postsampling filter mass weighing after conditioning should be within $\pm$ 5% of the presampling conditioning environment.

9.0.0 POSTSAMPLING FILTER WEIGHING

9.1 After conditioning, remove the racks containing the postsampling filters from the cabinets and retrieve the 24-Hr Report sheets. Match up the ID numbers on the petri-slides and on the 24-Hr Report sheets and place them on the bench top near the selected balance. Place filters in an orderly fashion on static charge neutralizers adjacent to the microbalance.

9.2 Calibrate the microbalance as described in Sections 5.1, 5.2, and 5.3. After calibration, at the start of each weighing session, re-weigh one of the three **lab blank** filters. These are filters that have been conditioned, weighed, then left continually exposed in the cabinets where sample filters are conditioned (see Section 7.15). Record the weight of the lab blank and the date in the QC notebook and initial the record. At least once a week, also weigh the other two lab blanks and similarly record their weights. The average weight change for these filters should not exceed 15 micrograms per day of exposure. If this limit is exceeded, consult with the laboratory supervisor before weighing any sample filters. Long-term results can also be used to measure the mass stability of the Teflon filters over time.

9.3 Prompt the LIMS database to generate a **PM2.5 Mass Postweight Analysis** work list by selecting a **work list** function from the Main Menu. Next, enter the test name: **pm25**. Give the work list a file name: (e.g., **FM- (fine mass) MM/DD/YY**) which designates the test and the current date. Default the other prompts until the mass worklist is generated. Check the worklist for the appropriate number of duplicates (at least 10%), field blanks, and check standards. Accept the worklist only after all the samples registered on the worklist match the samples identified on the selected 24-Hr Report sheets. This includes all the selected routine samples, field blank samples, check standards, and duplicates. Once the worklist is generated and accepted, no changes can be made.

9.4 Prompt the LIMS database to select **Postweight Balance Weighing** from the Main Menu. Enter the prompt **post** and type in the worklist file name. The computer will display the first filter number and corresponding preweight. Begin weighing as described in Sections 7.6 and 7.7, except that when the mass read-out appears on the LCD, screen record the value on the 24-Hr Report sheet in the "postweight" space. Then transmit the data to the LIMS database, and proceed with the next sample. After 9 individual filters have been weighed, which may include field blank filters, LIMS will prompt for weighing a **check standard** and then a **duplicate** sample filter. The filter number of the duplicate will be the same as the original filter, except for the inclusion of the letter **D** after the number. Record the duplicate's weight on the 24-Hr Report. Also record the date of postweighing on the 24-Hr Report. Filters shipped and stored at 4 degrees Celsius or lower before conditioning must be weighed within 30 days of the sampling date; filters shipped and stored between 4 and 25 degrees Celsius before conditioning must be weighed within 10 days of the sampling date. Any "out of date" samples must be so noted on the 24-Hr Report and reported to the laboratory supervisor.

9.5 If mass difference between the preweight and postweight of a "field blank" filter is greater than 30 micrograms, "flag" that filter and notify the site operator and the lab supervisor. If mass differences between the original and replicate mass read-outs from a postweighed duplicate are greater than 15 micrograms, flag that filter and notify the lab supervisor.

9.6 If, after postweighing, the filter will receive further analysis, return it to the conditioning container, close the container tightly and note on the conditioning container that additional analyses are required. Transfer the filter, along with any special comments on a copy of the 24-Hr Report, to the lab responsible for performing additional analyses.

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APPENDIX C

DATA QUALIFIERS / FLAGS

MONITORING & LABORATORY DIVISION

OCTOBER 2001

Appendix C

Data Qualifiers/ Flags

A sample qualifier or a result qualifier is an indicator of the fact and the reason that the subject analysis: (a) did not produce a numeric result, (b) produced a numeric result, but it is qualified in some respect relating to the type or validity of the result, or (c) produced a numeric result, but for administrative reasons, is not to be reported outside the laboratory.

A numeric code is used for invalid data. A code of “Y” or “N” indicates a data flag. A three-letter alphabetic code represents a data flag indicating the data is qualified in some respect and may be invalidated.

Table C-1
Field Qualifiers

Code	**Definition**	**Description**
9977	Contamination	Contamination including observations of insects or other debris
9976	Filter Damage	Filter appeared damaged
Y or N	Elapsed Sample Time	Elapsed sample time out of specification
See Table C-3	Event	Exceptional event expected to have effected sample (dust, fire , spraying etc)
9976	Field Accident	There was an accident in the field that either destroyed the sample or rendered it not suitable for analysis.
FAT	Failed Ambient Temperature Check	Ambient temperature check out of specification
FIT	Failed Filter Temperature Check	Filter temperature check out of specification
Y or N	Flow Rate	Flow rate 5 min avg out of specification
Y or N	Filter Temperature	Filter temperature differential, 30 minute interval out of specification
9995	Failed Multi-point Calibration Verification	Failed the initial Multi point calibration verification
FPC	Failed Pressure Check	Barometric pressure check out of specification
9986	Failed Single Point Calibration Verification	Failed the initial single point calibration verification
9980	Leak suspected	internal/external leak suspected
9980	Sampler Damaged	Sampler appears to be damaged which may have affected filter.

Table C-2
Laboratory Qualifiers

Code	Definition	Description
ALT	Alternate Measurement	The subject parameter was determined using an alternate measurement method. Value is believed to be accurate but could be suspect.
<2	Below Detectable Limits	There was not a sufficient concentration of the parameter in the sample to exceed the lower detection limit in force at the time the analysis was performed. Numeric results field, if present, is at best an approximate value.
9984	Canceled	The analysis of this parameter was canceled and not performed.
FBK	Found in Blank	The subject parameter had a measurable value above the established QC limit when a blank was analyzed using the same equipment and analytical method. Therefore, the reported value may be erroneous.
FCS	Failed Collocated Sample	Collocated sample exceeded acceptance criteria limits
FFB	Failed Field Blank	Field blank samples exceeded acceptance criteria limits.
9984	Failed Internal Standard	Internal standards exceeded acceptance criteria limits.
9984	Failed Laboratory Blank	Laboratory blank samples exceeded acceptance criteria limits.

Table C-2
Laboratory Qualifiers (cont.)

9984	Failed Laboratory Duplicate	Laboratory duplicate samples exceeded acceptance criteria limits.
9984	Failed Quality Control	The analysis result is not reliable because quality control criteria were exceeded when the analysis was conducted. Numeric field, if present, is estimated value.
HTE	Holding Time Exceeded	Filter holding time exceeded acceptance criteria limits.
9976	Improper Sample Preservation	Due to improper preservation of the sample, it was rendered not suitable for analysis.
9984	Laboratory Accident	There was an accident in the laboratory that either destroyed the sample or rendered it not suitable for analysis.
9984	Rejected	The analysis results have been rejected for an unspecified reason by the laboratory. For any results where a mean is being determined, this data was not utilized in the calculation of the mean.
<2	Analyzed But Undetected	Indicates material was analyzed for but not detected

Table C-3
List of Events for PM2.5 Mass Concentrations

Code	Description
A	High Winds
C	Volcanic eruptions
D	Sandblasting
E	Forest fire
F	Structural fire
G	High pollen count
H	Chemical spills and industrial accidents
J	Construction/demolition
K	Agricultural tilling
L	Highway construction
N	Sanding/salting of streets
O	Infrequent large gatherings
P	Roofing operations
Q	Prescribed burning
R	Clean up after a major disaster
S	Seismic activity

Table C-4
Projected PM2.5 Log-In Parameters

#	Parameter	Entry
1	Site Name	Chemist Picks from List or FTP from Field
2	Barcode	Scanned in by barcode reader
3	Diff Pre-Wt/Begin Sampling (Hrs)	LIMS Calc after Post-Wt
4	Flag Pre-Wt/Begin Sampling	LIMS Flags if Calc Hrs>720 (30 Days)
5	Filter Removal Date/Time	Chemist Enters at Log-In
6	Diff End Sampling/Filter Removal (Hrs)	LIMS Calc after Log-In
7	Flag End Sampling/Filter Removal	LIMS Flags if Calc Hrs>96 (4 Days)
8	Shipping Temperature (C)	Chemist Enters at Log-In (<4,4 to 25,>25)
9	Flag Shipping Temperature	LIMS Flags if Chemist entered >25
10	Days Until Post-Weight	LIMS Calc either 10 or 30
11	Post-Weigh Filter By	LIMS Calc Date
12	Diff End Sampling/Post-Wt (Days)	LIMS Calc after Post-Wt
13	Flag End Sampling/Post-Wt	LIMS Flags if >Days Until Post-Wt Field
14	Date Rec'd in Lab	Chemist Enters at Log-In
15	Diff End Sampling/Date Rec'd (Days)	LIMS Calc after Log-In
16	Sampling Date (MM/DD/YY)	Chemist Enters at Log-In or FTP from Field
17	Sampling Time (HH:MI)	LIMS Defaults 00:00
18	Sampling Frequency	LIMS Defaults Every 6, 3 or 1 Days (AIRS)
19	Scheduled Run Day?	LIMS Defaults Yes, Chemist can enter No
20	Make-Up or Extra Sample	Chemist Enters if Schd=No
21	Sampling Date Being Made Up	Chemist Enters if Make-Up Sample
22	Comments	Chemist can Enter Anything
23	Sample Invalid?	Default=No, Chemist or LIMS can change to Yes
24	Invalid Reason	Chemist or LIMS Enters if Sample Invalid=Y (AIRS)
25	Local Condition Code	Chemist Enters, Default=No Unusual Cond (AIRS)
26	Flag Filter Temp Differential	Chemist Enters at Log-In or FTP from Field (AIRS)
27	Elapsed Time (HH:MI)	Chemist Enters at Log-In or FTP from Field
28	Elapsed Time (minutes)	LIMS Calc after Log-In (AIRS)
29	Flag Elapsed Time	LIMS Flags if Time <1380 minutes (AIRS)
30	Elapsed Time for Conc Calc (minutes)	LIMS Defaults 1440, LIMS Changes if Time <1380
31	Volume (M3)	Chemist Enters at Log-In or FTP from Field (AIRS)
32	Flow CV (%)	Chemist Enters at Log-In or FTP from Field (AIRS)
33	Flag Flowrate	Chemist Enters at Log-In or FTP from Field or LIMS Flags if CV%>2 (AIRS)
34	Avg Ambient Temperature (C)	Chemist Enters at Log-In or FTP from Field (AIRS)
35	Min Ambient Temperature (C)	Chemist Enters at Log-In or FTP from Field (AIRS)
36	Max Ambient Temperature (C)	Chemist Enters at Log-In or FTP from Field (AIRS)
37	Avg Ambient Pressure (mmHg)	Chemist Enters at Log-In or FTP from Field (AIRS)
38	Min Ambient Pressure (mmHg)	Chemist Enters at Log-In or FTP from Field (AIRS)
39	Max Ambient Pressure (mmHg)	Chemist Enters at Log-In or FTP from Field (AIRS)

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APPENDIX D

QA AUDIT SOPS
(See Appendix Z and Appendix AA of Volume V)

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APPENDIX E

FIELD OPERATIONS AND CALIBRATIONS SOPS
(See Appendix AI, Appendix AJ and Appendix AK of Volume II)

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